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UNIVERSITY OF CALIFORNIA, IRVINE

**Shiva's Rangoli: Tangible and Interactive Storytelling
in Ambient Environments**

THESIS

submitted in partial satisfaction of the requirements for the degree of

MASTER OF SCIENCE

in Information and Computer Science

by

Saumya Gupta

Thesis Committee:

Assistant Professor Joshua Tanenbaum, Chair

Professor Katie Salen Tekinbaş

Professor Constance Steinkuehler

2018

Table of Contents

List of Figures.....	iv
List of Tables.....	v
Acknowledgements	vi
Abstract of the Thesis.....	vii
Chapter 1. Introduction	1
1.1. Overview	1
1.2. Research Questions	6
1.3. Thesis Structure	7
Chapter 2. Literature Review	8
2.1. Tangible User Interfaces.....	8
2.2. Tangible Narratives	9
2.2.1. Diegetic Objects	11
2.2.2. Cultural Tangible Narratives	13
2.2.3. Story Authoring Platforms	15
2.2.4. Other Tangible Narratives.....	16
2.3. Interactive Environments	16
2.4. Affect and Ambiences.....	18
2.5. Agency, Meaning, and Transformation	20
2.6. Narrativized Interfaces.....	23
2.7. Gaps in Literature	24
Chapter 3. Design and Implementation	27
3.1. Installation Experience.....	27
3.1.1. Rangoli Interface	29
3.1.2. Ambience Effects.....	32
3.1.3. Narratives	34
3.1.4. Creating Story Endings.....	38
3.2. Implementation.....	39
3.2.1. Table Top	39
3.2.2. Rangoli Rings	41
3.2.3. Hardware.....	43
3.2.4. Software	43
3.2.5. Tent.....	43
3.3. Design Process	44
3.3.1. Inspiration.....	44
3.3.2. Early Designs	46
3.3.3. Early Hardware Prototypes	47
3.3.4. Pilot Tests.....	48

Chapter 4. Methods	49
4.1. Research Questions	49
4.2. Methods for Study	50
Chapter 5. Findings	53
5.1. Ambience	53
5.2. Interaction Styles	58
5.3. Roles and Diegetic Connections	67
5.3.1. Roles	67
5.3.2. Diegetic Rangoli and Ambiences	70
5.3.3. Limitations of Connection with Characters	73
5.4. Design	74
5.4.1. Novelty Effect	74
5.4.2. Understanding the System	76
5.4.3. Mismatches, Misconceptions, Distractions	77
5.4.4. Feedback	81
5.4.5. Summary of Learning and Interactions	82
5.5. Cultural Findings	83
5.6. Creating Story Endings	86
5.7. Summary	88
Chapter 6. Design Implications	90
6.1. Ambience and Emotional Spaces	90
6.2. Writing the Narrative	92
6.3. Diegetic Interfaces	95
6.4. Supporting different types of interactions	98
6.5. Developing Literacy	100
Chapter 7. Answering Research Questions	102
Chapter 8. Conclusion and Future Work	110
References	113
Appendix A. The River	120
Appendix B. The Medicine	126
Appendix C. Interview Questions	132

List of Figures

Figure 2. 1	The Reading Glove (Tanenbaum et. al, 2010, 2011).....	12
Figure 2. 2	Genie Bottles (Mazalek, 2011)	13
Figure 2. 3	Olfactory experience in Sensing History (Chu et. al, 2016).....	14
Figure 2. 4	Offering table by Ranjit Makkuni (Makkuni, 2018)	15
Figure 2. 5	Ambient environments by Ross and Keyson (2007)	17
Figure 2. 6	Presentational styles in Scarlet Skellern (Tanenbaum & Tomizu, 2007). ..	19
Figure 3. 1	Concept Illustration of Shiva's Rangoli	28
Figure 3. 2	The tent and the space inside the Tent	29
Figure 3. 3	Traditional Rangolis	29
Figure 3. 4	Rangoli Interface	30
Figure 3. 5	Four sets of Rangoli rings	31
Figure 3. 6	Reader assembling the Rangoli	32
Figure 3. 7	Russel's Circumplex Model mapped with colors from eMoto (Fagerberg et. al, 2004)	32
Figure 3. 8	Different ambient effects from top-left clockwise: angry, happy, calm, sad	34
Figure 3. 9	Center pieces made by participants	39
Figure 3. 10	Table top	40
Figure 3. 11	Switch assembly and back of rings	40
Figure 3. 12	Layers of the table top.....	41
Figure 3. 13	Different rings and the center pieces	42
Figure 3. 14	Few assembled Rangolis	42
Figure 3. 15	Making of the rings.....	42
Figure 3. 16	Electronic components below the table and the LEDs	43
Figure 3. 17	Tent installation.....	44
Figure 3. 18	Cardboard prototype with coins and Makey Makey	47
Figure 3. 19	Early wooden prototypes.....	48
Figure 4. 1	Visualization of themes	52
Figure 5. 1	P02's interaction style timeline	64
Figure 5. 2	P18's interaction style	65
Figure 5. 3	General learning curve	82
Figure 7. 1	Summary for RQ1 and RQ2	107

List of Tables

Table 3. 1	Ambient Effects.....	33
Table 4. 1	Participant Demographic Data.....	50
Table 5. 1	Interaction Style Summary	67
Table 5. 2	Roles that readers took	70
Table 5. 3	Learning how the system works	83

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Abstract of the Thesis

Shiva's Rangoli: Tangible and Interactive Storytelling in Ambient Environments

By

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Master of Science in Information and Computer Science

University of California, Irvine, 2018

Assistant Professor Joshua Tanenbaum, Chair

This work presents *Shiva's Rangoli* – a tangible interactive storytelling installation that allows readers to impact the emotional tone of the story by sculpting the ambience of the space they are located in. The installation is culturally rooted in Indian mythology and the traditional art form of Rangoli making. I propose meaningful forms of interaction and design implications for tangible storytelling experiences in ambient environments.

I designed and implemented *Shiva's Rangoli*. To evaluate the installation, I interviewed participants based on their experience using it. The findings suggest that people can engage in different and meaningful ways with a narrative by impacting its emotional tone through crafting the ambience of their environment. The findings also reveal that ambiences and tangible interfaces can play diegetic roles to connect the reader with the story, by existing in both the reader's world and the story world.

I propose how to design an interactive story that allows readers to engage at a level of its emotional and aesthetic context, without having control over the story's plot. I recommend ways to design interfaces that act as diegetic bridges between the world of the reader and the world of the fiction. I study how people interact with culturally specific interfaces for interactive storytelling. I also investigate if people are motivated to engage creatively with such a system.

Chapter 1.

Introduction

The 11-year-old was thrilled to take the wand from the shopkeeper as felt the magic radiating through her veins. She was now equipped and ready to finally enter the enchanted world of magic, leaving the muggle world behind. As she stepped outside the shop, the thirty-year-old snapped back into reality, feeling grateful for the few moments that transformed her world into one she had only read and dreamt about. – Ollivander's Wand Shop, an interactive storytelling experience based on Harry Potter at Universal Studios, Hollywood.

Such experiences testify the power of interactive storytelling and their ability to bridge the gap between the reader's reality and the world of fiction. There are various design aspects that come together to give people these transformational moments. What kind of interactions should people have in these experiences? How is a touching and impactful narrative delivered while balancing the reader's interactions? How can experiences support readers to feel as if they are a part of the story world? In our quest to answer these questions, we have created and evaluated a tangible and interactive storytelling installation, *Shiva's Rangoli*.

1.1. Overview

Why is storytelling important?

The art of storytelling has been an integral part of our existence. Stories can teach us about history, lineage, culture, world views and many other pedagogies. They also carry the ability to transport us into fictional worlds, allowing us to see the world from the author's creative standpoint as we temporarily escape our own worlds. The most powerful stories stimulate us emotionally, urge us to reflect and rethink our views, and help us see things from different perspectives. We listen to stories for entertainment and creative stimulation, we tell stories to articulate our thoughts and opinions, and we evolve and progress through stories that inspire and move us.

What is interactive storytelling and why should we care?

Technology has transformed the art of storytelling in various ways. Storytelling has developed beyond carvings, folktales, scriptures, and novels into televisions, digital interactive media, internet-based web series, interactive narrative based games, and mixed reality. Along with the change in media, the way we engage with stories has also transformed. With the help of technology, stories can be told through more interactive experiences alongside traditional methods. In such interactive experiences, the story progresses based on the reader's interaction with the narrative as the reader has a stake in how the narrative unfolds. This can help the reader personalize the story and their experience, derive complex and different meanings, interpret the story in different ways, transform to be a part of the fictional world, and establish a personal connection with the narrative.

Interactive storytelling has the power to create aesthetic experiences that can motivate us to act meaningfully, reflect on our views and actions, think critically, and to engage creatively. These platforms can create memorable experiences that can touch readers in impactful ways. I will always remember my journey inside Universal Studio's Hogwarts castle as the mixed reality experience transported me into one of my most beloved fictional worlds. Interactive storytelling can blend art and technology in innovative ways to explore new avenues for creatively engaging authors, listeners, and interactors. With this goal, I venture into my thesis, *Shiva's Rangoli* - an interactive and tangible storytelling installation based on Indian mythology and culture.

What makes a story interactive?

Interactive narratives and narrative-based gameplay have explored many forms of interaction such as non-linear stories, changing viewpoints, telltale stories, and branching pathways. Many of these systems, term 'interactivity' as freedom over the narrative, giving readers the ability to change the story's plot. This design favors the player's interactions over the narrative content. Although such experiences can be pleasurable, they favor the reader's interactions over the author's core story, often delivering narratives that have weak impacts. They generally leave less room for reflective thinking or for making meaningful choices (Tanenbaum & Tanenbaum, 2009; Nay & Zagal, 2017). This degree of freedom over the story plot can also force the author to create branching pathways of the story, leading to combinatorial explosions, weakening

the narrative even further. The question then becomes to explore ways that balance the author's narrative content with the reader's interactions, encouraging readers to act in meaningful ways and delivering impactful narratives.

Tanenbaum and Tanenbaum (2009) propose a new definition for agency in interactive narrative based games – the process by which participants in an interaction commit to a meaning. They emphasize the importance of decoupling the reader's interaction with the story's plot and creating opportunities that encourage people to hold themselves responsible for the outcomes of their actions. Salen and Zimmerman (2004) define the occurrence of meaningful interactions when player actions and game outcomes are integrated into the larger context of the game. *Shiva's Rangoli* is based on these emerging definitions of redefined agency in interactive narratives and gameplay. I explore how readers interact with a narrative where they have agency over the emotional and aesthetic context of the story that gives them the ability to change the mood and tone of the narrative without having any impact on the story's plot / narrative arc. I aim to give readers the opportunity to engage meaningfully with the story, transform to connect with the story world, and experience an impactful narrative.

Emotional shades of a story

I believe that giving readers agency over the emotional context of a narrative can facilitate meaningful interactions. The mood, tone, and emotions of characters and the story can impact the narrative in powerful ways. This can allow readers to personalize their experience with the narrative without changing the story's content. This gives the readers agency over 'how' a character feels and performs a certain action rather than 'what' action the character performs (Tanenbaum, 2015). Such forms of agency can help readers see the story from different perspectives and interpret the narrative in ways meaningful to them.

Tanenbaum & Tomizu (2007) have defined and explored this concept by developing an interactive digital storybook that sought to decouple the interactions of the reader from the events of the plot by modifying the presentational style of the story in response to the reader's interactions, thus engaging the readers in an affective dialogue with the characters. In *Shiva's Rangoli*, we take this form of agency further by allowing readers to configure the aesthetic elements of the ambient space in which the reader is situated, thereby influencing the mood and tone of the story. Readers change the

lighting, background music, and sound effects of their space to create an environment that sets an emotional tone to the narrative as well as their physical space. The mood and tone of certain characters and events in the story changes as a result of these interactions. We explore how readers interact with a narrative through this form of agency.

How do we connect the reader's world with the fictional world?

Interactive storytelling can bridge the gap between the reader's reality and the world of fiction as it carries the capability to transport the reader into the story world. However, many interactive narratives use desktops or mobile phones to deliver narrative based media. System that use the screen, mouse, and keyboard create a boundary between the reader and the story, as they demand readers to focus on the screen and interface, instead of enabling their actions to be part of the storytelling experience. I believe that interactive narratives can break this boundary by creating tangible interfaces that are a part of the reader's physical world and connect meaningfully with the story. Hence, such interfaces can enable the reader to be a part of the story, rather than disconnecting them through traditional desktop-based interfaces (Mazalek, 2001b). Furthermore, tangible interfaces merge into our physical world and facilitate more natural ways of interaction as compared to screen-based interfaces (Ishii & Ullmer, 1997). For these reasons, we have created a tangible interface for Shiva's Rangoli.

Tangible interfaces open a realm of possibilities for connecting readers with the story. 'Diegetic' objects act as boundary objects that exist in the reader's world alongside existing in the story world (David & Kristin, 1997; Star & Griesemar, 1989). A few tangible narratives such as Genie bottles (Mazalek, 2001a) and the Reading Glove (Tanenbaum et. al, 2010, 2011) have explored the use of diegetic objects and have shown promising results in the way readers interact with the story. Genie bottles is an interactive narrative where the interface comprises of three beautifully crafted glass bottles. Readers open the flasks and hear different genies come out of these bottles to tell their story. The bottles exist in the reader's physical world as an interface, while also existing in the fictional world as homes to the genies. The act of opening the bottle not only progresses the narrative, but also makes the reader feel as if they are a part of the story world. I believe that such tangible diegetic objects and interfaces can blur the boundary between the reader's world and the narrative. Hence, we have created a

diegetic interface for *Shiva's Rangoli* as it acts as a shared object between the reader and the characters of the stories. Furthermore, we transform the physical space of the reader to mimic the environment of the fictional world, hoping to bridge the gap even further.

A cultural lens to storytelling

Storytelling is a universal art and people from all around the world with diverse backgrounds have unique narratives that offer various perspectives. These stories can tell the world about a culture's traditions, heritage, mythos, lifestyle, values, and viewpoints. Listening to stories from various backgrounds not only enriches our knowledge of the world but allows us to think from different point of views. They enable us to empathize with people outside our own communities and help us become more accepting and understanding, evolving us as individuals in the process. Interactive storytelling can provide engaging and entertaining platforms for introducing people to different cultural tales. For these reasons, *Shiva's Rangoli* has been designed with a set of non-western cultural assumptions underlying its functional and semantic element. The tangible interface is rooted in Indian traditions as it depicts an Indian artform called Rangoli Making. Rangolis are elaborate colorful patterns that are made during festivals in India. The stories are works of fiction inspired by Indian mythology and they highlight the morals that are emphasized in Indian mythos.

Lastly, *Shiva's Rangoli* also provides a story authoring platform where readers are asked to record their personalized versions of story endings. I wish to study how people extend their cultural understanding of the experience into their crafted endings. The story authoring platform aims to encourage readers to engage with the system creatively, participate in the art of Rangoli making, think of ways to extend the narrative, listen to other people's authored content, and collaboratively share their ideas and viewpoints of the narrative.

What is Shiva's Rangoli?

Shiva's Rangoli is an interactive and tangible storytelling installation based on Indian mythology and culture. The installation enables readers to craft the ambience of their physical space (lights, sound, music, and video) through a Tangible User Interface (TUI) (Ishii & Ullmer, 1997), subsequently composing an emotional context for the

stories by impacting the mood and tone of the characters and the narrative. Readers hear two interleaved audio narratives within the context of this configurable ambience. *Shiva's Rangoli* attempts to bring Indian traditions and myths into a technological, tangible, and narrative environment. The TUI represents a traditional Indian artform called Rangoli Making and the narratives have been inspired by Indian Mythology. The TUI also acts as a diegetic interface as it is a part of the physical world of the reader as well as the fictional world of the stories. The Rangolis created by the reader through the TUI represent the Rangolis created by the protagonist in the narratives. The environment of the fictional world transforms to match the ambience of the physical space created by the reader. Readers of *Shiva's Rangoli* are invited to assume the role of the protagonist (Shiva) while interacting with a diegetic interface that connects them with Shiva's world.

1.2. Research Questions

I am interested in exploring how people engage with interactive narratives at the level of a story's emotional and aesthetic context. I want to investigate the role of and propose design implications for diegetic interfaces in tangible interactive narratives. I wish to study how these experiences are perceived if they are created from a unique cultural perspective. I also want to explore how people engage with the system creatively. My broad research questions are:

RQ1: How do people interpret and interact with a narrative where they can craft the ambience of their space to impact the emotional and aesthetic context of the story, without changing the plot?

RQ2: How do people engage with diegetic interfaces in an interactive narrative?

RQ3: How do people perceive an interactive storytelling experience through a non-western cultural lens?

RQ4: Do people engage creatively with the story authoring platform? What motivates them to create?

I have elaborated on these questions further in the methods section of the thesis.

1.3. Thesis Structure

In the thesis, I discuss the literature, design, implementation, and findings of *Shiva's Rangoli*, concluding with design implications for such tangible interactive narratives. The structure of the thesis is as follows:

Chapter 2 gives the literature review of the existing work on Tangible User Interfaces (TUIs), interactive tangible narratives, TUIs in physical spaces, ambiences and affect, agency meaning and transformation, and narrativized interfaces. I identify the gaps in the literature that have inspired our work on *Shiva's Rangoli*. Chapter 3 gives an overview of the design and implementation of the installation. I explain the interactive experience, implementation, and the iterative design process. Chapter 4 discusses the research questions and methods used to evaluate the installation – user studies, interviews, and qualitative data analysis. In Chapter 5, I elaborate on my findings, specifically on the role that ambiences played in the interaction, different interaction styles, the role of diegetic objects and how they aided transformation, system design strengths and flaws, findings based on the cultural aspect, and story authoring views. In Chapter 6 I discuss design implications for creating interactive narratives that give agency over the mood and tone of the story, how ambiences can be used in such interactive narratives, and how to author such narratives. I also give guidelines for designing effective diegetic interfaces, guidelines for designing to support different agencies and multiple interactive possibilities, and the importance of developing literacy. In Chapter 7, I summarize my work and derive answers to the research questions, while grounding my work in the existing literature. Chapter 8 concludes the thesis and elaborates on future directions.

Chapter 2. Literature Review

In this section, I first give a brief overview of tangible user interfaces, their history, and the recent research directions. In the tangible narrative section, I elaborate on how tangibles have been used in storytelling. I discuss topics relevant to *Shiva's Rangoli*, such as diegetic objects, cultural narratives, and story authoring platforms. I then briefly discuss works on interactive ambient environments. I further elaborate on how few systems have used ambient environments to set an emotional context. I also explain concepts of agency, transformation, and meaning in narrative-based games, as they describe the intention for this research. I conclude this chapter by identifying gaps in existing literature that have been key to the motivation and design of the installation.

2.1. Tangible User Interfaces

Ishii and Ullmer (1997) coined the term Tangible User Interfaces (TUIs). They discuss how we process information through haptic interactions and physical objects, yet most of our interactions with computers take place through screens. They elaborate on how we can use physical objects to interact with technology rather than using screens that demand focused attention. They coined the term 'Tangible Bits' to bridge the gap between technology and the real world, by making digital information physical. They describe three key concepts: Interactive surfaces, coupling of bits and atoms, and ambient media. They discuss how foreground interactions can take place by interacting with TUIs and how background interactions can be used to communicate data in the periphery by changing light, sound, etc. They describe their work metaDESK and transBOARD where physical objects in the foreground are used to communicate with interactive surfaces. metaDESK explores interactions with graphically-intensive applications through TUIs, and transBOARD is a whiteboard that absorbs information from the physical world and translates the data into the digital world. They also describe their work on AmbientROOM, which is a room where data is represented in the periphery through lights and patterns. These visualizations do not demand attention, rather they are a part of the background.

In further work on TUIs, Ishii et. al (2012) highlight the need for making tangible interfaces flexible enough to represent changes in digital information. Hence, they

coined the term Radical Atoms where digital information can have physical manifestations allowing direct manipulation and interaction.

Fernaes et. al (2008) propose a new set of ideals for evolving the practice in TUIs. They highlight four themes – a shift from information centric to action centric, designing for interactions in context rather than for the properties of the system, supporting shareable use rather than just individual use, and allowing for multiple subjective interpretations instead of objective interpretations. They elaborate on incorporating the ‘practice turn’ in HCI for including a human centric approach in TUIs.

2.2. Tangible Narratives

Many works have explored how tangible interfaces can be used in storytelling. People have used transformational environments for storytelling as well. Harley et. al (2016) propose a framework for the analysis and design of tangible narratives by identifying common themes and gaps in existing literature. Their framework categorizes works based on the primary users of a system, media used, narrative function of the tangible objects, diegetic tangibles, narrative creation, narrative choice, and narrative position.

Primary users are identified as the system’s primary audience – mainly children or adults. The media describes the use of a particular medium for feedback. The narrative function of the tangible objects explains the purpose that the interface serves in the story – as a navigational tool or as a metaphor of the story component. Diegetic tangibles are those tangibles that exist parallelly in the story world and the real world. The authors write *“it does not simply represent a story component, it is the story component.”* Narrative creation identifies whether the system allows interactors to generate content. Narrative choices are implicit and explicit. Implicit choices are a part of the system’s basic interactions. The consequence of the interaction is known after the interaction takes place. Explicit choices can possibly lead to a change in the narrative and the consequences are known before the interaction takes place. Narrative positions are defined as the reader’s position in the narrative. It can be internal or external, ontological or exploratory. When readers take an internal role, their interactions are a part of the story world and they often adopt the role of a character. In an external role, readers are outside the narrative and are distant from the level of the story’s characters.

In an exploratory position, readers learn about the story components, maybe even re-arranging events in the process. In an ontological position, readers can alter the story world that can leave a history of change.

The authors categorize twenty-one tangible storytelling works based on the framework. They also identify gaps in these existing works. Tangible storytelling systems rarely consider a specific demographic. They are generally location specific and most of them do not afford longer narratives that can be positioned in private settings. Most of the systems that cater to adults allow story exploration, and the systems that cater to children allow story content creation. There are also very few systems that have diegetic tangibles. The authors perceive diegetic objects as a good alternative to using tangibles as metaphorical or input devices. They also claim that there are less systems that allow readers to take an internal ontological role. This role allows people to connect to the narrative and take responsibility for the consequences. Many systems are external-exploratory and treat the interaction as a puzzle to be solved rather than concentrating on the narrative. They also discuss how the physical space, different narratives, and longer narratives can impact the story telling experience. In future work, they speculate how gestures and physical spaces can act diegetic. They identify the need to study these systems from the interactor's perspective and how their role relates to the story.

Paiva (2005) describes the role of tangibles in interactive storytelling. She identifies the need to balance user's activity along with the author's narrative plot. Interactors should not just take a passive position, they should emotionally connect with the characters and have the ability to influence outcomes. She claims that readers should be able to act and make a difference in the way the stories progress. She also explains how systems should afford a shared world experience, where the interface and the physical space can be a part of the story world. This idea overlaps with diegetic tangibles. She believes that tangibles play an important role to achieve a seamless coupling between the story world and the real world, as purely digital interfaces separate these world through a screen. She believes that supporting users through tangible objects can build successful gateways between the realms of fiction and reality. She also elaborates on the importance of creating systems that allow expressions of emotions.

The sections below describe different themes in tangible narrative that are central to the thesis - diegetic objects, cultural contexts, story authoring, and interactive environments.

2.2.1. Diegetic Objects

David and Kristin (1997) define the term 'diegetic' as "*things that exist within the world of the film's narrative.*" Tangible storytelling systems use diegetic objects as objects that exist both in the reader's world and in the story world. Harley et. al (2016) and Pavia (2005) describe the importance of using diegetic objects to connect the readers with the fictional world.

Star and Griesemer (1989) coin the term 'boundary objects' as "*objects that inhabit several intersecting social worlds and satisfy the informational requirements of each of them.*" They describe that these objects can adapt to local needs and constraints across several worlds and still maintain a common identity. These objects exist between opposing world views and bridge the gap between different perspectives. This term can be seen from a storytelling perspective as well (Tanenbaum et. al, 2010). In *Shiva's Rangoli*, ambiences and the Rangoli TUI hold different meanings in the reader's world and the fictional world. However, they maintain a common identity of setting emotional tones in both worlds.

The Reading Glove (Tanenbaum et. al, 2010, 2011) shown in figure 2.1 is an exemplar of using diegetic objects in tangible narratives. Readers interact with different objects to hear various lexicons of the story. The story is a thriller about a spy who is on the run. The narration is from a first-person perspective and unfolds in a non-linear style according to the reader's interactions. The authors discuss how readers oscillate between immediacy and hypermediacy (Bolter & Grusin, 1999), that is from immersion to awareness, while interacting with TUIs. They coin the term 'present – at -mind' and explain ways that TUIs can adopt this term to avoid oscillation between immediacy and hypermediacy. Present-at-mind highlights semantic and meaningful representations of the objects used as the interface. They describe their findings for experiencing the reading glove, which have been pivotal for the creation of *Shiva's Rangolis*. They argue that if physical systems over determine the look and feel of the story, it may lead to less imagination and less contribution from the readers. They highlight how the objects

helped readers to connect with the character, as they would mimic the actions of the character by picking up the objects that they would hear the narrator pick up. Readers expressed how they could identify with the main character through these objects, as they could feel what the character was going through. The authors elaborate on their design implications as a result of their findings. They discuss designing a role for the interactor to enact within a system, the importance of building literacy and giving explicit permission to readers to interact with the objects, designing open interpretive experiences that allow people to make meaning of their interaction in different ways (Sengers & Gaver, 2006), and the use of boundary objects to bridge the gap between the real and fictional world.



Figure 2. 1 The Reading Glove (Tanenbaum et. al, 2010, 2011)

Other tangible storytelling systems that have used diegetic objects are Genie Bottles (Mazalek, 2001a) and Every Object tells a Story (Holmquist 2000). Genie bottles is an interactive system consisting of three beautifully made glass bottles as shown in figure 2.2. Readers open these bottles and hear different genies come out of these bottles to tell their story. If two bottles or more are opened at the same time, the genies start talking to each other. This work also highlights the importance of maintaining balance between user interactivity and the author's narrative plot. The user's interactions and the bottles, both are diegetic as they occur in the real world and the story world. This was one of the earliest works I had read on tangible narratives and I was struck by the simplicity, aesthetic quality, and diegetic interaction. Every Object Tells a Story is a system where objects have memories and readers access these objects to hear a segment of the memory. The objects hold different perspectives of the same event in which all these objects were present. The authors felt that using less number of objects

was a limitation in their design. They also speculate having several objects that are shared between different people to hear the whole narrative.



Figure 2.2 Genie Bottles (Mazalek, 2011)

The number of current storytelling systems using diegetic objects are less, however they make a strong case of connecting the worlds of the reader and the story.

2.2.2. Cultural Tangible Narratives

Within the area of tangible storytelling, only a few works have been dedicated to exploring non-western cultural contexts. These systems are the exception to the norm within tangible storytelling research. Harley et. al (2016) also recognize that tangible narratives do not target any specific demographic. I speculate on the works that have looked at tangible storytelling from a culturally specific lens, making technological interactions rich in diversity.

Renati represents oral and digital narratives of viewpoints from South Africa in the form of installation art (Chenzira et. al, 2008). Four characters give their perspective about living under apartheid in South Africa. The authors acknowledge the need of boundary objects in their work.

Mapping Place is a tangible tabletop museum exhibit that encourages exploring African culture through story creation (Chu et. al, 2015). The authors identify opportunities to understand how tangible narratives can help in learning cultural heritage. The tabletop enables people to learn symbols and non-linguistic concepts that are used by the Lukasa board. The Lukasa board is a wooden board studded with beads, shells and carvings that represent pieces of stories. This board shows the

history, cosmology, and genealogy of the Luba people. The Mapping Place table top mimics this board and allows making, mapping, and sharing of stories using interactive beads and shells. The authors infer that tangible interactions can support collaborate learning and help people learn different cultural practices if the knowledge is contextualized. They also point out that design should reinforce learning goals to avoid unintended interpretations.

Sensing History is another museum exhibit that uses tangible objects to engage people with 16th century inspired prayer nuts through narratives (Chu et. al, 2016). They aim to bring museum-based artifacts closer to people through sensory and embodied interactive experiences. The authors describe three interactions– visual voyage, experiencing spirituality, and scents of power. People interact with a prayer nut to unfold a visual story that gives the context and meaning of the prayer nuts. Two other objects are placed on the table that when opened display the ingredients used for the fragrance of the prayer nuts, also providing an olfactory experience (figure 2.3). The authors highlight the importance of familiarizing people with the subject matter and possible interactions for better engagement.



Figure 2. 3 Olfactory experience in Sensing History (Chu et. al, 2016)

ShadowStory is a digital narrative system that allows children to explore their creatively through a system inspired by Chinese shadow puppetry that aims to engage them in their local heritage (Lu et. al, 2011). They inspire to find ways to preserve and pass on their rich cultural heritage. Although their work is not strictly in the tangible space, they encourage children to create, collaborate and perform stories through a digital shadow puppetry interface.

StoryBeads is a tangible system that aims to preserve the cultural knowledge of the South African BaNtswana culture (Reitsma et. al, 2013). They mimic the practice of

using beads to tell stories through technology. The system affords recording and listening to stories through eBeads.

Ranjit Makkuni is an interaction designer who builds interactive and culturally rich installations in museums (Makkuni, 2018). His work has been inspirational for the design of the Rangoli Interface. A few of his pieces that inspired me were the Ayurveda installation that explores the tradition of Ayurveda and yoga, the offering table that recreates the concept of offering flowers during traditional ceremonies (figure 2.4), and a flute tree where people blow the branches of a tree to hear traditional Indian music.



Figure 2. 4 Offering table by Ranjit Makkuni (Makkuni, 2018)

2.2.3. Story Authoring Platforms

Many tangible narratives platforms afford authoring of story content. StoryMat allows children to record stories on a play mat with the help of a stuffed animal, as children move around on the mat. It also enables generating content collaboratively (Ryokai & Cassel, 1999). TellTale is a hybrid physical-digital system that enables children to create, edit, and share stories (Ananny, 2002). The tangibles are in the shape of a capitellar with five pieces attached to the body. Children can record and re-arrange story segments through these pieces. TellTable enables children to create stories by drawing and using objects to take and edit pictures in their stories (Cao et. al, 2010). This can also be used for collaborative creation. TOK is a story authoring platform that enables children to create stories using different cards with their respective visualizations on a tablet (Sylla et. al, 2013). Phylactery is a rare story authoring system targeted towards adults (Chaudhari & Tanenbaum, 2016). It allows people to record their

memories associated with heirloom objects by placing them on a wooden platform. These stories can be heard once the object is placed back on the platform.

2.2.4. Other Tangible Narratives

There are a few other tangible storytelling systems that I would like to mention. Sentoy is a doll made for children that allows them to manipulate a virtual character's emotions and actions to move the story forward (Pavia et. al, 2002). Triangles is a system that tells the tale of Cinderella in a non-linear manner. Each triangle piece represents a character, an event, or a story setting, which when joined with other pieces, narrates a scene in the story (Gorbet et. al, 1998). Tangible viewpoints is a storytelling system that focuses on representing a story from multiple viewpoints (Mazalek et. al, 2002). The user interacts with pawns to unfold the story, where every pawn represents a character. The story has multiple forms of media attached to it. The system also understands the user's preference over time and goes deeper into one character's story if the reader interacts more with one pawn. If not, the story weights all characters equally. When two pawns are touched together, a scene that is relevant to both characters is revealed.

This section gave an overview of tangible narratives. In the next section, I concentrate on how physical spaces have been used to create interactive environments.

2.3. Interactive Environments

A few tangible and embodied systems make physical spaces interactive by using different ambiances and environments.

The Kid's Room is an interactive physical space which engages children in storytelling by using images, narration, lights, and sound to transform a child's bedroom into a fantasy story world (Bobick et. al, 1999). They aim to create a physical space for collaborative interactions. The story starts in the child's bedroom and guides them through multiple landscapes such as forests, river worlds and monster worlds. The interactive room recognizes the children's voices and actions and responds accordingly. The authors of StoryRooms explore affordable ways for making interactive storytelling and story authoring experiences in physical spaces (Alborzi et. al, 2000). Story rooms

reveal narratives based on the interactions that take place. The authors propose affordable and understandable hardware and software solutions through which children can participate as authors for these stories.

Ross and Keyson (2007) propose a tangible expressive interface that enables people to sculpt the ambiances in a living room through lighting, audio, and video art as shown in figure 2.5. They emphasize that interactions should shift from 'use' to 'presence' as they seamlessly integrate with the environment. They also highlight the need of shifting from task-oriented interactions to experience driven interactions that encourage people in creativity, playfulness, and self-expression. These theories have been key to our work on *Shiva's Rangoli*. Ross and Keyson describe a case study of a TUI that gages warmth, activity, and, attention of a space and in response allows people to sculpt different home atmospheres. They concentrate on designing TUIs for expressive interactions.



Figure 2. 5 Ambient environments by Ross and Keyson (2007)

Li and Jianting (2009) propose an intelligent ambient space used for emotional physical communication. They propose a networked ambient environment that interprets emotions based on movements in the space. This emotion is then communicated from the sender's space to their loved one by changing the ambience of their room through lights, color, music, and images that relate to the emotion. This is one of the rare works that transforms the physical space to represent emotions.

Ishii and Ullmer's work on the AmbientRoom (1997) discusses how data can be represented in the periphery of one's vision through subtle changes in lights, wall displays, and patterns. They elaborate on how this data does not need to be the focus point for the user, rather it can stay in the background and be referred to when needed.

2.4. Affect and Ambiences

In this section I describe the systems that use ambient and aesthetic effects to set an affective preference. By ambient effects I refer to any information in the background such as color, sound, music, light, video or images.

Tanenbaum's work on *Saculet Skellern* and the *Absent Urchins* (Tanenbaum & Tomizu, 2007) has been influential in the design of *Shiva's Rangoli*. The authors have created a digital storytelling piece where the readers have influence over non-plot centric aesthetic and presentational elements of the narrative, that allow the reader to view the story in different genres, engaging them in an affective dialogue with the characters. They discuss their motivation by highlighting how most interactive storytelling systems give readers control over the plot, which at times undermines the author's narrative. The authors cite Murray's core aesthetic principle of digital media – Agency, Immersion, and Transformation (Murray, 1997). They explain how their work satisfies these principles by giving readers agency over the aesthetic preference of the story, facilitating cognitive interaction, and by supporting the transformation of the digital environment as per the reader's actions. They discuss how they have modelled the system to understand the reader's preference, make meaning out of their choices, and act accordingly. Throughout the course of the story, readers interact with different objects and make different choices, which gages their emotional preference. These choices can be major or minor and are weighted accordingly while changing the presentational style of the story. The story's color scheme, ambient sound effects, and music continuously transition to adapt to the reader's preferences. Hence, the narrative can be represented in different genres – melancholy, happy, and scary. The ambience transitions continuously, and the higher the preference for one particular genre, the stronger are the effects of the music, sound, and color pertaining to that genre (figure 2.6). The authors cite Dipaola and Arya's work (2006) on affective communication and how music and art can cause or express different emotional states. They also cite theories from visual arts that explain how colors can set certain moods (Ocvirk et al. 1994; Wallschlaeger and Busic-Snyder 1992). A formal user study was not conducted, however they observed that readers were interested in using the system in the debug mode, where readers themselves could change the aesthetics of the story. This finding guided our design process for *Shiva's Rangoli*, where readers are given explicit agency over the ambient

and emotional context of the story. The authors propose changing certain text in the narrative to set the emotional context, another design implication that has been implemented in this work. Lastly, they describe that a story can be made neutral by creating different characters with distinct personalities that amplify certain moods, as they believe this can allow multiple emotional interpretations. My findings extend this design implication further. This work proposes a balance between the author's plot and the reader's interaction, without undermining either of their goals. The authors argue that narrative meaning emerges not only out of the plot, but also out of context and style.



Figure 2. 6 Presentational styles in Scarlet Skellern (Tanenbaum & Tomizu, 2007)

Based on *Scarlet Skellern* and the Reading Glove, Tanenbaum has proposed a framework for the design of interactive narratives (Tanenbaum, 2011). He highlights the challenge to support meaningful reader interactions with plot coherence. The constructs of this framework are – narrative model, interactive model, and system model. The narrative model helps designers think of what constitutes the narrative. The interactive model questions what the interactor desires and how they pursue their goals. The system model helps designers realize the tools that are present and the tools that are needed to achieve the two goals above.

A few other systems have used different presentational styles to set emotional contexts. *Papous* is a virtual storyteller that uses a character to present different stories (Silva et. al, 2001). The story writer can control this character's emotions, action, gestures, surrounding environment, and scene. Different tags are given to the story writer to achieve the same. This work caters towards story authors rather than readers. *The Influencing Machine* is a cultural probe, that invites users to reflect on the meaning of affective computing (Sengers et. al, 2002). Users can insert postcards in a wooden box, which then makes the agent react in an emotional way to the postcards inserted. This response changes the soundscape and the dynamics of the graphics seen by the users. The mailbox influences the emotions of the agent and the perception of the users.

Ada is a live soundscape composition that reacts to people's interactions through a variety of sensors (Wassermann et. al, 2003). The intelligent space uses sound and light to communicate its emotions. Color changing floor tiles, corridors giving a view of what happens inside Ada, changing graphics on the walls, and music, all help Ada to communicate its emotional state. Etree is an artwork where an augmented-reality based tree reacts by reading the emotional preference of people through their interactions with the tree, interactions of people amongst each other, and spontaneous reactions of people (Gilroy et. al, 2008). The authors have used a PAD model for their design. The tree grows in ways that reflects how it perceives the user's response. MobiMood is a social mobile application that allows groups of friends to communicate their moods with each other through different colors (Church et. al, 2010). eMoto explores ways to design for emotional expressions in mobile phones (Sundström et. al, 2005; Fagerberg et. al, 2004). eMoto assesses the user's emotional response by the way they interact with a stylus on the mobile phone and in response, changes the background of the text messages that they send. The background uses different animations, shapes, and colors to express the emotional state.

A few theories based on colors and emotions have guided the design for *Shiva's Rangoli*. Russell's Circumplex model of affect identifies emotions as values of valence – positive or negative feelings, and arousal - high or low energy (Russell, 1980). Many emotions are categorized and visualized on the quadrants created by these two parameters. The authors of eMoto have mapped colors, shapes, and animations to the Russell's circumplex model of affect (Ståhl et. al, 2005). They describe how darker shades represent intense emotions and light shades represent milder emotions. They also give different shades of colors, shapes, and animations to each quadrant. I refer to these models in the design section.

2.5. Agency, Meaning, and Transformation

In this section, I elaborate on concepts of agency, meaning, and transformation studied from the perspective of narrative-based games. I believe these theories play an important role in the experience design of *Shiva's Rangoli*. My results highlight how these concepts can be used in the domain of interactive tangible narratives.

Tanenbaum and Tanenbaum (2009) suggest a new definition for agency for narrative-based games. They state that agency should be seen as the process by which people in an interaction commit to a meaning, rather than viewing agency as freedom of choice. They cite existing definitions of agency in games by Murray (1997), Salen and Zimmerman (2004), and, Mateas and Stern (2006). These authors describe agency in different ways, but with a common theme – games should support meaningful choices and actions within some boundaries and constraints set by the game. The authors argue that this kind of agency opposes the player’s goals and the designer’s ability to author compelling work. The authors elaborate how agency is used as an illusion in some games, where players feel that they are in control, but the result is independent of the player’s choices. Hence, they feel empowered and feel that their actions were meaningful. The authors propose a new definition of agency as “*The process by which participants in an interaction commit to meaning.*” They discuss how agency should express intent rather than content and provide a response to that intent. They also discuss that meaningful commitment should be reinforced by the game’s behavior. They elaborate how facilitating player freedom towards meaningful expressions can help players and designers work as collaborators, especially in narrative based games.

Recent work by Iten et. al (2018) on interactive narratives attempt to answer what comprises of meaningful choices, and how systems can encourage readers to think before they act. The authors studied responses to a variety of digital games and found two types of choices (moral and social) to be impactful and meaningful when people felt their choices had immediate consequence. Moral choices were those that put players in moral dilemmas, and social choices impacted other characters in the game. Their findings reveal that the presence of these mechanics significantly impact appreciation, yet the explicit option of making a choice only increases appreciation when the choices have highly impactful consequences. They further support the argument that adding choice to a narrative can be effective only if these choices as perceived as meaningful. They state that further research should focus on how emotional interactions can create meaningful choices.

Nay and Zagal (2017) explore meaningful choices within gameplay from a virtue ethics perspective. They argue how ‘inconsequential choices’ that deliver the same outcome irrespective of the choice can help players reflect meaningfully on their actions rather than focusing on which outcome to choose. They believe that allowing players to

craft the character's perspective and development can provide opportunities for moral experiences and reflection. They appreciate how the game, *Life is Strange* allows players to travel back in time to change their character's response and portray the character according to their preference. The authors emphasize that ethical meaning can be derived from gameplay that provides inconsequential choices.

Tanenbaum (2015) describes design poetics that can help designers achieve agency as commitment to meaning, as described above. The author draws parallels from the narrative based game 'Mass Effect' in support of these proposed poetics. He defines agency and commitment to meaning as an occurrence when players not only express intentions, but also hold themselves responsible for the outcomes of their actions. I briefly describe these design poetics. Tanenbaum describes how games can give players opportunities to make meaningful commitments that result in explicit / major changes in the gameplay, or result in implicit changes, that are interpretations or choices that help derive meaning. He further discusses 'interpretive superposition' as a phenomenon where players are capable of committing to multiple and often mutually exclusive meanings simultaneously, at times pursuing contradictory goals. He describes how meaningful play occurs when player activities lead to some response by the system. These responses can be interpreted or misinterpreted by the player, which can create a web of rich and emergent meaning. He discusses static vs dynamic commitments in games, where the stakes are higher for long-term static commitments as compared to dynamic commitments. He refers to Salen and Zimmerman (2004) on how players must be made ready for static changes by establishing meaning of the action, giving immediate short-term feedback, and ongoing long-term feedback. The author further describes investigation vs progression as how every action does not need to be expressive of meaning, as some actions can be taken just to explore gameplay. Investigation should allow exploration by meaningful opportunities to manipulate the gameplay without resulting in long term effects, whereas progression should call for commitments. He elaborates how inaction can be considered a meaningful choice as well, since not taking an action can also lead to certain consequences. Lastly, he elaborates how commitment to meaning can also be about just moving forward in gameplay, rather than selecting a specific outcome. He describes how this can lead to enactment, where players act as if they have control over the situation. Tanenbaum concludes by explaining how this new perspective of agency and meaning perceives the

player as someone who is more interested in experiencing a good narrative rather than someone who is only interested in manipulating the system to emphasise their own preferences. Through my study, I observed how many of these implications can be applied to tangible narratives as well.

Tanenbaum (2015) describes the phenomenon of transformation as temporarily leaving behind one's own identity to experience the world from a different perspective. I briefly describe a few design poetics that are relevant to this study. The author discusses how scripts and situated rehearsals inserted in gameplay can help players transform into a defined role. He describes how endowing the players with narrative responsibility can help players surrender to the needs of the character. He also emphasizes that characters should not be a blank slate but rather have an expressive personality. Players should be allowed to inhabit and commit to this identity, leading to a feeling of responsibility for the character. He elaborates concepts of emotions, bleed, and creative states where emotions of the player are connected to emotions of the character in the game. This sync of emotions can lead to powerful creative states. He also states that creative states are disrupted when the represented choices make players reflect about their choice rather than react. He further elaborates how embodiment and masks can help transform players as they enact the character's actions. I observe parallels in my findings with the design poetics highlighted in this work.

2.6. Narrativized Interfaces

In this section, I discuss a few works that have influenced the design of the interface for *Shiva's Rangoli*.

Bizzocchi et. al, (2011) describe design approaches to integrate interfaces with the narrative of game-based systems. They describe how the 'look and feel' and aesthetics of the interface can be closely connected with the narrative. They further elaborate on how the frame of view of the player can impact the experience of the game. They discuss the concept of behavioral mimicking as a strategy where the physical behavior of the player's gameplay mimics real life actions. They elaborate on the importance of moving away from traditional gaming inputs such as computers, joysticks, and controllers to achieve this goal. They describe behavioral metaphors, where the interface can encourage players to build a connection with real world behavior rather

than mimicking it. They also emphasize the importance of bridging the real world and story world through mixed reality interfaces.

Tanenbaum and Bizzocchi (2009) describe a case study on the game Rock Band and how gestural and embodied interactions in gameplay can be understood as ludic, kinesthetic, and narrative experiences. They highlight common themes that emerge from these categories as dynamics of immersion, leveraging prior knowledge for embodied interactions, and the concept of the transparent interface as the interface seems to disappear during game play.

Macaranas et. al (2012) describe spatial and attribute metaphors that can help in the physical design of tangible user interfaces. They discuss how conceptual metaphor theory can be used to connect abstract meaning to physical attributes. This understanding has influenced *Shiva's Rangoli* TUI design as well.

2.7. Gaps in Literature

Tanenbaum and Tanenbaum (2009), Harley et. al (2016), Mazalek (2001b), and Pavia (2005) all acknowledge the need to balance the user's interactions with the author's story in interactive narrative-based systems. Tanenbaum & Tanenbaum highlight how giving readers freedom or choice over the storyline undermines the author's narrative plot. They discuss how designers should find ways for encouraging people to act meaningfully, rather than giving them control over the story plot, which can lead to combinatory explosions and branching pathways. Iten et. al (2017) state that the role of emotion in making meaningful choices in interactive narratives is worth further research. In *Shiva's Rangoli*, we take these ideas further and explore how readers interact with a tangible narrative, when they have agency over the story's mood and tone, and the character's emotions, but no agency over the plot. I explore how people can find meaningful engagement without changing the plot, and how we can design to support this concept further. I also investigate how theories of agency, commitment to meaning, and transformation from game design can be utilized in tangible interactive narratives. I further give implications for design for tangible narratives in support of these concepts.

Mazalek (2001b) and Mazalek et. al (2002) highlight ways to balance narrative coherence and user's interactions through non-linear narratives and interacting with stories from different point of views. However, these solutions still treat the interactor as an outsider, as they are not necessarily a part of the story, neither are they endowed with responsibilities and well being of the character, all of which can help in immersion (Tanenbaum, 2015; Harley et. al, 2016). I explore a solution that connects readers with the characters and makes them feel a part of the story by using diegetic interfaces and by giving readers agency over tone and mood, without compromising the narrative content.

Harley et. al (2016), Tanenbaum & Tanenbaum (2011), and Pavia (2005) emphasize the importance of diegetic objects in tangible narratives and how they can blur the boundary between the story world and the real world. Harley et. al (2016) also explain that there are less works that include the use of diegetic objects in tangible storytelling interactions. As a part of their future work, they highlight that physical spaces can also be diegetic. In *Shiva's Rangoli* I explore how the ambience of the reader's space can help them connect with the story world. To the best of my knowledge, this is the first work that explores how physical spaces and ambiances can act as diegetic. Furthermore, the Rangoli TUI itself is diegetic. I explore how both, the Rangoli interface in the foreground and the ambience in the background can help blur the line between the reader's world and the fictional world. I also propose implications for designing diegetic objects and how they can be inserted within the narrative and the experience, a design topic that has not been well explored. Pavia (2005) has expressed the need to identify ways to build effective gateways between the story world and the reader's world.

Harley et. al (2016) discuss that there should be more interactive tangible narratives that place the user in an internal-ontological position. They state that most works put interactors in external-exploratory positions which makes them feel as if they are solving a puzzle rather than truly connecting and acting meaningfully with the narrative, whereas internal-ontological positions can help readers connect to the character and the story and give them a sense of responsibility. *Shiva's Rangoli* puts readers in internal-ontological positions, as they can adopt the role of Shiva if they choose to do so. They can also influence the state of the story by changing the mood of the characters and the tone of the narrative. In addition, I provide implications for designing experiences that place readers in ontological positions. The authors highlight

that very few works give readers explicit choices over implicit choices during interactions. *Shiva's Rangoli* aims to provide both these choices. They also point out that studies in this domain need to capture the user's perspective, an approach that has been central to the study of *Shiva's Rangoli*.

I explore different ways in which people use ambiances to set an emotional context for a tangible and interactive narrative. I present design implications on how agency over aesthetics and moods can interplay with narrative content, without undermining the author's story plot or the user's interactions. I investigate how people interact with ambiances when given agency to sculpt their own ambient environment and affective preference. Most works in the space of affective computing try to assess the affective preference of interactors through abstract and metaphorical actions (Wassermann et. al, 2003; Sundström et. al, 2005; Li & Jianting, 2009), often not understood by the users. I explore how people interact with environments, where they are in control of sculpting of the ambient space and setting an emotional tone, along with access to knowledge on how to achieve the same. In this work, I ask for the interactor's affective preference rather than assessing it. This approach was guided by the findings of Scarlet Skellern (Tanenbaum & Tomizu, 2007), in which readers were more interested in the debug mode, where they were able to set the presentational style themselves, rather than having the system understand their actions and reacting accordingly.

Harley et. al (2016) acknowledge that there are limited works that provide story authoring platforms to adults. In this work, I have created a story authoring space for the readers, who can be adults or children.

There are very few works in the domain of tangible narratives that are culturally specific (Chenzira et. al, 2008; Chu et. al, 2015, 2016; Reitsma et. al, 2013; Lu et. al, 2011). Moreover, most of these works target learning or preserving cultural heritage. *Shiva's Rangoli* is based on Indian mythology and culture, making it a unique interface and interaction. However, the stories are fictional as they are only inspired by mythological facts, and the cultural interface has been metamorphically extended. Unlike other work, the goal of the installation is not rooted in education. It aims to introduce people to the aesthetic, cultural, and artistic nature of the interface, and to give them a different cultural lens in storytelling.

Chapter 3. Design and Implementation

In this chapter, I discuss the design and implementation of our tangible and interactive storytelling installation - *Shiva's Rangoli*. I first give an overview of the installation's experience. I give details about the specifics of its elements such as the TUI, the ambiances, and the narrative of the experience. Next, I elaborate on the implementation of the hardware and software. Further, I explain the motivations, iterations and earlier prototypes in the design process.

3.1. Installation Experience

Shiva's Rangoli is an interactive and tangible storytelling installation based on Indian mythology and culture. The installation enables readers to shape the ambience (lights, sound, music, and video) of their environment, through a TUI subsequently composing an emotional context for the stories as well as their physical space. Readers experience two interleaved audio narratives within the context of this configurable ambience. The TUI is culturally rooted as it depicts an Indian artform called Rangoli Making. Rangolis are elaborate colorful patterns that are made during festivals in India. The stories have been inspired by Indian Mythology. The TUI also acts as a diegetic/narrativized interface (David & Kristin, 1997) and a boundary object (Star & Griesemer, 1989) as it is a part of the physical world of the reader as well as the fictional world of the stories. Readers of *Shiva's Rangoli* are invited to assume the role of Shiva while interacting with a diegetic interface that is present in the physical world of the reader and the fictional world of the stories.

When readers enter the installation space, they are first introduced to the concept of Rangolis. They enter the installation, a small space enclosed by a tent. Inside the tent lies a table, twelve artistically patterned Rangoli rings and two center pieces. Three of these rings are placed on the table top in a concentric manner to create a Rangoli. Once the rings are placed on the table, they set the lights, ambient sound effects and music inside the tent. Each ring represents a particular mood based on its color – happy, calm, sad or angry. The rings effect the ambience of the space based on the mood that they are mapped to. Hence, the space adapts to the mood created by the reader through the TUI. The two center pieces represent two different yet inter-related

narratives. Once the reader places the center piece on the table, the Rangoli is complete. Upon this completion, a chapter from one of the stories, represented by the center piece is triggered and narrated through audio. The chapter adapts to the emotional tone set by the ambience as a few mood based textual elements in the narrative change accordingly. Further, an ambient video is displayed based on the emotional tone to augment the mood of the space. The Rangoli gives the reader agency over the emotional tone of the story, and the aesthetic and mood setting of the space.

In the narratives, God Shiva the protagonist, creates Rangolis to express his emotions. The environment of the story world transforms to reflect Shiva's Rangolis and his state of mind. The Rangolis made by the reader in the tent represent the Rangolis made by Shiva in the narratives. Hence, the Rangolis give the reader control over Shiva's mood, and the ambience of the story world. Furthermore, both the Rangoli and the ambience created by the readers are diegetic as they connect readers to the story world. The stories consist of 10 chapters each. After every chapter, readers are required to reassemble or change pieces of the Rangoli to proceed to the next chapter. Figure 3.1 is a concept illustration of the installation space. Figure 3.2 shows the inside of the tent. This experience was designed for readers to take internal – ontological narrative positions as described by Harley et. al (2016).

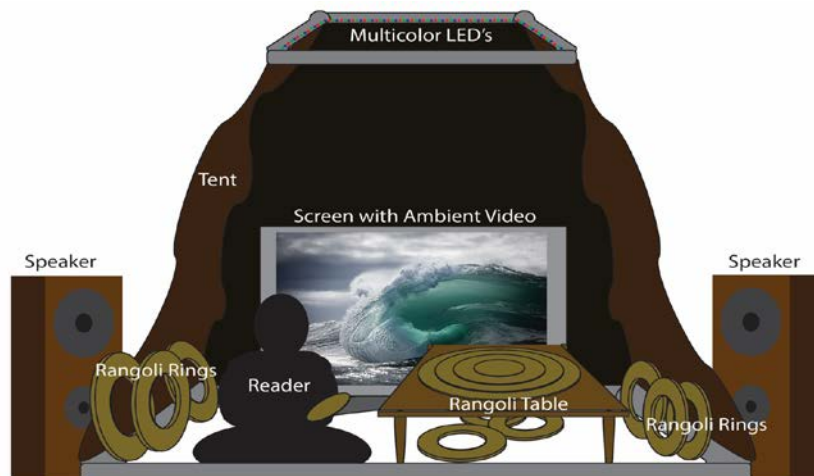


Figure 3. 1 Concept Illustration of Shiva's Rangoli



Figure 3.2 The tent and the space inside the Tent

Towards the end readers are given the option of recording their own version for the story endings by creating their own center piece and ambience. They can also choose to listen to what other people have recorded.

3.1.1. Rangoli Interface

The TUI is inspired by the Indian art form of Rangoli making. Rangolis are colorful patterns that people make on the floors of their homes for celebrating various festivities. Traditionally, they are created with repetitive patterns that represent geometric shapes, deity impressions, nature representations, etc. As time has progressed, Rangoli designs have been adapted and transformed into modern impressions. Rangolis are made from rice, powdered flour, vermillion, turmeric, natural or chemical colors, petals, flowers and small lanterns. Figure 3.3 represents a few Rangolis.



Figure 3.3 Traditional Rangolis

The TUI mimics traditional Rangolis created out of repetitive shapes and patterns. It consists of concentric rings that are put together to create a Rangoli. Figure 3.4 shows the interface.



Figure 3.4 Rangoli Interface

This interface was also inspired by Ranjit Makkuni's work (Makkuni, 2018) on culturally rooted interfaces and experiences. His work has been displayed in many museums and lies at the intersection of traditional cultures, art, design and technology. A few of his works that inspired me were the Ayurveda installation that explores the tradition of Ayurveda and yoga, the offering table that recreates the concept of offering flowers during traditional ceremonies, and a flute tree where people blow the branches of a tree to hear traditional Indian music. The Rangoli TUI was created to be a 'narrativized interface' as it connects the readers to the story, enables them to mimic the character's actions, and represents abstract concepts of mood and emotions (Bizzocchi et. al, 2011).

Three of the concentric rings and a center piece are placed on the table to complete a Rangoli. There are four sets of three rings each (twelve rings) and two center pieces. Each set of rings represents a particular mood – happy, calm, angry or sad. In each set, there are three rings of varying sizes (inner, middle, and outer ring) that have the same color and pattern as they map to the same mood. The yellow ring represents happy, green represents calm, blue represents sad, and red represents angry. This

design choice was informed by the color mappings used in the eMoto project (Ståhl et. al, 2005; Fagerberg et. al, 2004) and grounded in Russell's circumplex model of affect (Russell, 1980). Figure 3.5 shows images of the four different sets of rings. The inner rings set the music for the space, the middle rings set different sound effects, and the outer rings set the lighting inside the tent. The ambient effects are also mapped to the mood settings. For example, a happy upbeat instrumental song is played for the yellow ring, while a war-like, aggressive instrumental song is played for the red ring. The effects of each ring on the ambience are explained in further detail in the next section.



Figure 3.5 Four sets of Rangoli rings

The two center pieces represent the two narratives. Once all four pieces are aligned on the table to create a Rangoli, a chapter from the story represented by the aligned center piece is narrated through audio. Once the narration is complete, readers can reassemble or change parts of the Rangoli. As soon as all four Rangoli pieces are aligned again, the next chapter of the center piece's narrative is triggered.

The tabletop is a foot tall and readers are expected to sit down on the floor to assemble the Rangolis, mimicking the traditional Indian style of creating Rangolis on the floor. A chair was placed inside the tent for people who were uncomfortable in this position. Figure 3.6 shows a reader assembling the Rangoli.



Figure 3.6 Reader assembling the Rangoli

3.1.2. Ambience Effects

The Rangoli sets the ambience inside the tent based on the mood that the rings of the Rangoli represent. For simplicity, I have selected four moods represented by Russell's circumplex model of affect. The model categorizes emotions based on valence (negative or positive feelings), and arousal (high or low energy). Figure 3.7 shows the model, and a color mapping to this model represented by the authors of eMoto (Fagerberg et. al, 2004). Happy has high arousal and high valence, calm has low arousal and high valence, sad has low arousal and low valence, angry has high arousal and low valence.

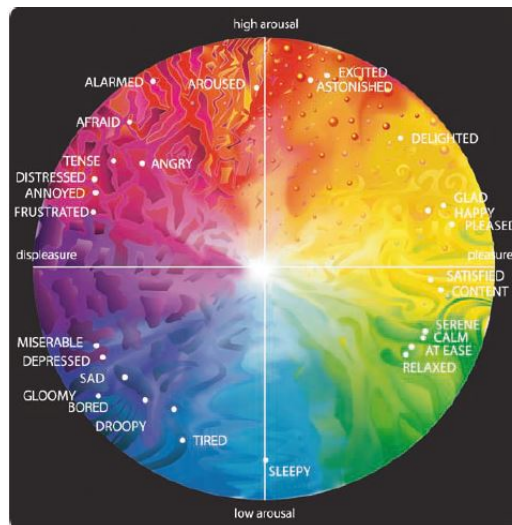


Figure 3.7 Russel's Circumplex Model mapped with colors from eMoto (Fagerberg et. al, 2004)

Based on this model, I selected different effects for the lights, sound, music, and video. In the narratives, God Shiva's Rangolis impact the state of the world by shaping

the ambience on Earth, as a reflection of Shiva's mood. Hence, the ambient effects have a nature-based theme to them. Further, a holy river is an integral part of both the stories, and thus the ambient effects have the river central to them as well.

The yellow – happy rings create a warm, upbeat, and chirpy ambience. The green - calm rings create a soothing and soft ambience. The blue – sad rings create a low and dull ambience. The red - angry rings create a stormy, thundering ambience. These effects were decided after iterative user tests. I do not make any claims on the universality of these mappings with moods. The details of the effects are given in table 3.1. The media content (sound, music, and video) belongs to artists who have listed their work under the creative commons license agreement of YouTube.

Table 3.1 Ambient Effects

Mood	Lights (LED strip)	Sound	Music	Video
Happy (yellow)	Yellow lighting with a few LEDs dynamically changing colors	Day time noises near the river side, water flowing, and birds chirping	Upbeat, lively instrumental music (like music used in commercials)	Variations of a river stream flowing near the mountains in broad day light
Calm (green)	Green lights dimming and brightening, giving a pulsating effect	Stream of constant flowing water	Soothing instrumental music, (music that can put you to sleep)	Relatively calm waters in a lake, by the sea, and near a brook with soothing colors
Blue (Sad)	Blue lights with occasional LEDs blinking white	Water drops dripping slowly	Slow, low, and gloomy instrumental music	Slow flowing water near an icy mountain, near a lake at night time
Red (Angry)	Red lights that occasionally flash strobes of white giving a lighting effect	Thunderstorm and heavy rain	Fast, tensed instrumental music (war-like music)	Aggressive sea and river in a thunderstorm at night

Figure 3.8 shows the different ambient spaces created when all rings of the same colors are placed. The system allows readers to place any combination of the rings available. The overall mood and tone of the space is calculated by the majority of the colors of the rings on the table. However, readers may create a Rangoli comprising of three different colored rings. In such situations, the overall mood tone of the space is calculated by adding the arousal and valence associated with each ring. The summations of the arousals and valences represent the aggregate mood. An ambient

video of the river reflective of this aggregate mood tone is played to enhance the emotional tone that has been set. Three videos each, are mapped to every mood. One random video is chosen out of the three, after the mood tone has been set. I make no claims on the quantitative accuracy of this approach. The videos intentionally show ambient visuals rather than visuals that explicitly support the narrative. This design decision was based on the implication highlighted by Tanenbaum & Tanenbaum (2009) that suggests physical systems which over-determine the look of the environment may decrease the reader's motivation to contribute.

Alongside the ambience, the voice and tone of the narrator also changes to reflect the emotional ambience of the space. For simplicity, the narrative tone and voice changes based on valence alone. Hence in happy and calm spaces, a positive tone of voice is used. In angry and sad ambiances, a more negative tone of voice is used.



Figure 3. 8 Different ambient effects from top-left clockwise: angry, happy, calm, sad

3.1.3. Narratives

I authored the narratives, they are fictional pieces inspired by Indian mythology. The sub-sections below explain how the interface and ambience connect with the stories, the content of the stories, how the Rangolis set an emotional context to the narrative, and the interactions that take place between the reader and the stories.

Diegetic Rangoli and Ambiences

In the stories, Shiva is a powerful God who creates Rangolis to express his emotions. The God's emotions trickle down into the human world as well, as the Earth's ambience / environment reflects Shiva's mood and the colors of his Rangolis. For example, when Shiva is angry, the fictional world's skies become bloody and dark with heavy rains and raging thunderstorms. Readers are given agency over Shiva's emotions and ambiances, as the Rangolis that the readers create represent the Rangolis made by Shiva. The Rangolis shape the ambience of the fictional world as well as the space in the tent, to blur the boundary between the real world and the fictional world. Hence both, the Rangoli and the dynamic ambiances in the tent, are designed to serve as diegetic, connecting the reader to the story world.

Aside from Shiva, a magical river called Jhanvi is a common theme that flows across both stories. Hence, the ambient effects (sound and visuals) have been inspired by water, to give readers a sense of being near the river. Since the river is closely tied with Shiva, her ambient sounds and visuals reflect Shiva's mood as well.

Narrative content

The first story is about three Gods, Brahma the God of creation, Vishnu – the God of maintenance, and Shiva - the god of destruction. The story highlights the importance of the cycle of creation, maintenance, and destruction. The story starts with a deep intense argument when Brahma and Vishnu ambush Shiva by expressing their unhappiness on how Shiva destroys everything they create and maintain. Shiva reminds them of how important destruction is in the cycle of life, however he gives in to their pestering and lets them create an eternal magical river. This river is called Jhanvi and she comes from the essence of God Shiva. Hence, she mimics Shiva's state of mind as she is presumed to be calm or raging in accordance with Shiva's mood. The river grants people what they wish for but only if their intentions are pure, if not Jhanvi teaches them a lesson in her own way. As the story progresses, the tale of the river loses its charm and humans start polluting her. Since she is eternal, she does not dry up but taints the world and human life with sickness and death. Brahma and Vishnu approach Shiva and plead him to stop the river. However, due to his vow of eternity, he is unable to take her away. The story ends with Shiva cleansing the river with heavy rains but flooding the Earth and destroying the human race as a result of the cleansing. He pacifies the other

Gods by reminding them how humans tainted nearly all their creations, asking them to create creatures that are worthy of the river and whatever else the Gods offer.

The second story is about a family living near the banks of river Jhanvi. The father, Vayu is a sincere devotee of God Shiva. The family earns just enough to get by and are content with their lifestyle. One-night Vayu's daughter falls extremely ill and the doctors are unable to cure her. Vayu prays to God Shiva for help, who directs him to river Jhanvi. The river judges Vayu as pure of heart and gives him magical water to cure his daughter. Vayu's daughter recovers her health, but the disease starts to spread in the village. Soon, Vayu realizes that he is the only one with the cure and starts to imagine a life full of prosperity for his family. He starts to sell the holy water to those in need. However, karma visits Vayu as his wife falls ill when he runs out of the magical water. Vayu pleads the river for more holy water hiding the fact that he sold what he had left. The river helps him, and his wife recovers, yet he starts to see the water again. This time villagers get paralyzed because of the holy water. Vayu runs to the river begging her and Shiva for forgiveness, as he realizes that river Jhanvi saw right through him and punished him for his greed. Shiva asks Vayu to atone by feeding the village, and Shiva would cure the villagers once Vayu makes up for his sins. The story is left open ended on whether or not the villagers regain their health.

Interleaving Stories

These stories are told over ten chapters each. Readers assemble Rangolis before every chapter to hear the next narrative lexicon. The readers can choose to listen to one story at a time by replacing the same center after every chapter or they can choose to interleave their experience by exchanging the center piece after every chapter. The chapters of each story are always played in a linear order.

Changing emotional context of narratives

Each chapter has two versions: a positive valence version and a negative valence version. For simplicity, I have only taken valence of emotions into account and not arousal. The system reads the overall valence value of the Rangoli assembled by the reader and triggers one of the two versions for a chapter. In both versions, the story plot remains the same, but the tone and emotional context of the story changes. Shiva's mood, river Jhanvi's waters, the weather on Earth and some minor consequences not

effecting the plot, are different between both versions of each chapter. Since the plot of the stories never changes, the narratives do not branch out at any point. Alongside the text, the narrator's tone, volume and pitch are different between both versions as well. Here is an example of both positive and negative valence versions of one of the chapters.

Positive valence version: Shiva was in the midst of making the perfect Rangoli, a beautiful symmetric pattern on the floor of his abode. Shiva often practiced this art form to express himself, as his Rangolis reflected how he felt. The Rangolis would shape the ambience of the heavens and everywhere on earth, mirroring his state of mind. Brahma and Vishnu approached Shiva and as they looked upon the vibrant Rangoli filled with shades of yellow and green, they were delighted to see that Shiva was in one of his good moods. The skies were light, harmonious and chirpy reflecting Shiva's pleasure. Brahma and Vishnu, never thought twice before approaching him on such days, and so they decided that it was the perfect time to confront him on one of their never-ending arguments, Shiva's destruction.

Negative valence version: Shiva was in the midst of making the perfect Rangoli, a beautiful symmetric pattern on the floor of his abode. Shiva often practiced this art form to express himself, as his Rangolis reflected how he felt. The Rangolis would shape the ambience of the heavens and everywhere on earth, mirroring his state of mind. Brahma and Vishnu approached Shiva, and as they looked upon the bold Rangoli filled with shades of blue and red, they understood that Shiva was not in the best of his moods. The skies were dark, gloomy, and enraged, reflecting Shiva's displeasure. Brahma and Vishnu, always thought twice before approaching him on such days, yet today they mustered the courage to confront him on one of their never-ending arguments, Shiva's destruction.

As seen above, Shiva's mood and the state of the world change but the consequence of Brahma and Vishnu fighting with Shiva over his destruction does not change. This leaves the story at the same position to be continued in the next chapter.

Acknowledging Rangolis in narratives

In both stories, Shiva's Rangolis are acknowledged from time to time, to connect the reader with the stories, to remind them of their own Rangoli and how it connects with Shiva's Rangoli, and to help them confirm their understanding of which colors of the Rangolis represent which moods and emotions. Hence the ambiances and the acknowledgment of the Rangolis in the stories, both help readers understand the emotional context that the Rangolis set.

Generally, the Rangoli is acknowledged in a chapter, after the reader has assembled it. Hence readers connect the Rangoli they have made with the Rangoli that Shiva has made in that chapter. However, towards the end, readers are warned that Shiva's next Rangoli and mood will play a crucial role in the story. At this point, readers are made aware of the importance of the Rangoli before they assemble it for the next chapter. Here are examples from one of the stories that better explain how the Rangolis are acknowledged:

Acknowledging the Rangoli after reader's action: "Do you remember the beautiful ice age that once existed?" asked Brahma. "You just had to melt that down didn't you, Shiva?" Shiva's rangoli was turning into shades of yellow and green as he maintained his calm during the argument. He pacified Brahma, "The ice age had gone too far, and no living thing was able to survive in those conditions. It is that melt down that helped you create those humans."

Acknowledging the Rangoli before reader's action: Vishnu and Brahma were extremely anxious. "Shiva, the river will kill the humans, we can no longer control her. She must be stopped" said Vishnu. As Vishnu and Brahma continued to pester Shiva, Shiva sat down and started creating a Rangoli, a form of art he practiced to clear his mind. Brahma and Vishnu looked down at the Rangoli, trying to assess Shiva's state of mind, and thus the fate of the river Jhanvi that lay in his hands.

In later chapters of the thesis, I call this difference acknowledging the Rangoli before reader's action vs. acknowledging the Rangoli after reader's action.

3.1.4. Creating Story Endings

After the readers have listened to both the narratives, they are given the option to record their own version of an ending of a story. Readers are given a blank center piece that they can decorate. They set up an ambience with the Rangoli rings for their recording and place their center piece on the table to start recording. Once they are done, they pick up the center piece to stop the recording. They are asked to leave the center pieces outside the tent. In addition, they can pick up any of the center pieces left by other people to listen to what others have recorded. As soon as a recorded center piece is placed on the table, the recording is played, and the ambience adapts to the ambience created by the person who recorded the narrative attached to the center piece.

The second story has been intentionally left open ended, in hope for people to create their own version of the ending. Figure 3.9 shows few of the different center pieces created by people.



Figure 3.9 Center pieces made by participants

3.2. Implementation

This section describes the implementation of major components of the installation - the table top, the rings, the hardware, the software and the tent.

3.2.1. Table Top

After iterating through a variety of designs, we settled on a simple analog solution for detecting which rings were placed on our tabletop. When a ring is placed on the table top, a *keyed* tab fits into a socket, activating a momentary switch connected to a MaKey MaKey (2012). A connected laptop detects the circuit closure and triggers the playback of sound effects, music, and video.

The table top has different shaped sockets with snap switches fit inside these sockets. A snap switch closes as soon as enough weight is placed on it, completing a circuit connected to the Makey Makey. The back of each ring has a shape attached to it which acts like a key and fits into a particular socket on the table. Magnets stuck below the table and the rings help the reader snap the ring into the correct position, locking the shape into the socket, and producing a satisfying tactile experience when placing the rings. The magnets help to press down the switch and keep the rings in place. Small tape pieces aligned on the table and the rings give the reader a general idea of where to

position the ring. Figure 3.10 show images of the table top, and Figure 3.11 shows a detail of the switch assembly, and the back of a ring.



Figure 3. 10 Table top



Figure 3. 11 Switch assembly and back of rings

After making smaller prototypes, we realized that it would be difficult to pull the rings away from the table once the Rangoli is completely assembled, as there would be no space left between the rings to afford the same. We did not want to leave spaces between rings due to aesthetic reasons. Hence, we decided to place each ring position (inner, middle, outer) at different heights on the table. The outer ring is placed at the lowest layer with the center piece positioned at the highest layer. Thus, the table was made with five layers of wooden slabs to achieve the same. We carefully cut out holes for magnets, switches, and the socket shapes on every layer, ensuring that the cut outs on the top slabs went all the way through into the bottom slabs. We also made sure that the switches fit well into the cut outs, so they would not slip out. Figure 3.12 shows an image of these layers.

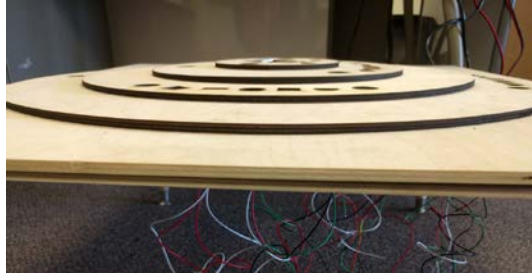


Figure 3. 12 Layers of the table top

These stencils were created on Adobe illustrator and the designs were cut out on wooden slabs using the laser cutter. The switches and magnets were attached to these cut outs using hot glue. The switches and the Makey Makey sockets were connected by soldering wires. After the layers of the table were in place, wooden legs were screwed onto the table.

3.2.2. Rangoli Rings

The art on the rings has been inspired by repetitive patterns used in traditional Rangolis. The color to emotion mappings have been guided by the findings of the eMoto project (Fagerberg et. al, 2004). We have used shades of yellow for happy, green for calm, blue for sad, and red for angry. The green and blue rings have less design work on them as compared to the red and yellow rings to map them to arousal. The red ring has been made with triangular and pointy shapes as they sometimes symbolize instability in Indian culture. I do not make any claims on the connection between the art and the emotions. The center pieces have symbols of the deities in the narratives.

This art was created on Adobe illustrator and the designs were cut out on wooden slabs using the laser cutter and the rings were then hand painted. The wood used for the rings is lighter in weight than the wood used for the table. The rings were then hand painted. Figure 3.13 shows the four rings – yellow (happy), green (calm), blue (sad), and red (angry) and the two center pieces for the two stories. Figure 3.14 shows a few assembled Rangolis and figure 3.15 shows the making of the rings.



Figure 3. 13 Different rings and the center pieces



Figure 3. 14 Few assembled Rangolis



Figure 3. 15 Making of the rings

A cut out shape and magnets were stuck to the back of each ring to ensure that the rings snap into place when placed on the table.

3.2.3. Hardware

Besides the Makey Makey, we have used an RFID reader to recognise the different center pieces. Each center piece has its unique RFID tag that is identified by the reader attached underneath the table. This allows us to have multiple center pieces for people to record their own story endings. The Makey Makey is kept underneath the table and is connected to the laptop. The Makey Makey emulates a key press as soon as a circuit is completed (snap switch is pressed). This allows the laptop to play different sound, music, and video tracks. The laptop also controls programmed patterns on a long strip of individually addressable RGB LEDs by HKBAYI, via an Arduino Uno, producing dynamic lighting ambiances within our installation. An external power source powered these lights. Figure 3.16 shows the electronics beneath the table top including the Makey Makey and the RFID Reader.



Figure 3. 16 Electronic components below the table and the LEDs

3.2.4. Software

The software to interact with the Makey Makey, RFID reader, and Arduino was written in Python. VLC Media Player was used for the audio and video effects.

3.2.5. Tent

The table top and rings are placed inside an enclosed *pavilion* created by suspending a metal frame from the ceiling of our lab and draping it with fabric and

curtains to produce a tent-like environment. The interior is lit using the aforementioned addressable RGB LED light strip, which is mounted along the border of the tent frame above the reader. Figure 3.17 shows the installation as built in our lab space. The interactor sits inside and assembles the Rangoli at a low table, paralleling the traditional practice of making Rangolis on the floor. A monitor is kept inside the tent for the ambient videos and a speaker is kept right outside the tent for audio.



Figure 3. 17 Tent installation

3.3. Design Process

In this section I first highlight some works that inspired me to build this system. I then go over my design process. I discuss early interaction designs and how they evolved. I also discuss how I iterated over the interface design. I deployed a few informal user tests for every iteration and learnt how to improve the experience as well as the interface.

3.3.1. Inspiration

I was inspired to pursue this work after I learnt about Tangible User Interfaces (Ishii & Ullmer, 1997) and their application in storytelling. Most of our interactions with technology happen through a screen, which force us to concentrate into a tiny screen to achieve our tasks. Tangible interfaces allow us to interact with technology through our

physical environment, in ways that are much more natural for us. I was intrigued by these ideas and delved further into the applications of TUIs.

I was fascinated by the use of tangible objects in storytelling environments to create engaging and immersive experiences. I liked the concept of diegetic objects being used to blur the boundary between the reader and the fictional world. *Genie Bottles* (Mazalek, 2001a) and *The Reading Glove* (Tanenbaum et. al; 2010, 2011) were two inspirational works that motivated me to investigate this topic further. Harley et. al's (2016) work on *Frameworks for Tangible Storytelling* helped me identify the gaps in this field and influenced my design choices.

I also found the concept of Ambient media (Ishii and Ullmer, 1997) and ambient systems interesting in terms of how media in the background of one's vision can be used for interactions. I wanted to bring this concept into storytelling which led me to think how readers in a storytelling experience could interact with the ambience around them. I felt that the ambient space could help set an emotional tone to the story.

This led me to my advisor's work on *Scarlet Skellern* (Tanenbaum & Tomizu, 2007), an interactive digital storytelling system, that understands the reader's aesthetic preference by assessing their interactions. The story then adapts to these preferences by changing the colors, sound, and music, and presenting the story in different genres (happy, sad, and scary). They emphasize on the plot of the story being independent of the reader's actions, to facilitate an interaction between the reader and the author, without undermining the author's core story plot. I found that other works also acknowledged that giving reader's control over the story plot can lead to narrative complexities (Mazalek, 2001b; Nay & Zagal, 2018). Furthermore, authors would have to write branching narratives and deal with combinatorial explosions. *Scarlet Skellern* presented a promising solution. However, the system did not undergo a formal user study and was left devoid of results.

I further read my advisor's work on agency and transformation (Tanenbaum & Tanenbaum, 2009) where he explains agency as commitment to meaning rather than freedom of choice. This further made me think of ways to deliver an impactful narrative and facilitate the readers to interact meaningfully with the stories without changing the story's plot.

Another gap that I identified in the current realm of interactive storytelling was the lack of cultural diversity in the stories and the interaction itself. To date, only a few projects have developed tangible interfaces and narratives that are rooted in non-western culture (Chenzira et. al, 2008; Chu et. al, 2015, 2016; Reitsma et. al, 2013; Lu et. al, 2011), which are exceptions to the norm. I wanted to root this experience based on my own background in Indian culture.

I also wanted to build a space where people could be motivated to engage in creative activities. This led to the story authoring part of the installation.

Lastly, I have always loved making. I was confident that I wanted to make an installation space to gain insight on my research questions.

3.3.2. Early Designs

In my earlier designs, I wanted to know whether ambiances in a space could influence the reader's perception of the story. Hence, in my first design iteration I connected the sad and angry ambience to story 1, and the happy and calm ambience to story 2. Readers would listen to story 1 if they created a negative valence ambience and story 2 otherwise. After the Rangoli TUI was designed, I made paper prototypes to test this with four people. Readers did not connect with the ambiances and were more engrossed in solving the puzzle.

I realized that my readers were not connected or immersed in the stories. I then looked back at the literature and decided to make the Rangolis diegetic, hoping to connect readers with the story. After that change, the ambience control through the Rangoli, the Rangoli expressing Shiva's mood, and the TUI being diegetic, all seemed coherent and well connected. The users responded well to the paper prototypes. However, I realized the need of acknowledging the Rangolis in the narratives multiple times to help readers understand the significance of the TUI and understand how the rings mapped to different emotions. This also reminded them of their agency over the Rangolis, Shiva's mood, and the ambience.

I then created a cardboard prototype. I realized that there were some chapters in the narratives that needed a better perspective to fit into one of the valence-based

categories - happy/calm or sad/angry. However, I felt a few chapters were key to the plot of the narrative and left them untouched.

3.3.3. Early Hardware Prototypes

I made paper prototypes for the first design iteration and deployed an informal wizard-of-oz style user study with four more people. I then made a cardboard prototype and connected all the hardware components. I used coins on the cardboard and the rings to complete the Makey Makey circuits. Figure 3.18 shows this prototype. I tested this prototype with three people. Alongside learning about improvements for the experience, I realized how difficult it was to pick up the rings from the cardboard as the other rings would move. Thus, I understood the importance of magnets for keeping the rings in place. I also observed that having no gaps between the rings would not afford easy placing and picking up of the rings. Hence, I decided to place each ring at a different height on the table. I also realized that coins were extremely inefficient in closing circuits. I was then introduced to snap switches by a lab-mate. The snap switches worked perfectly, and my advisor and I then designed the shape locking mechanism on the table and rings as described in the previous section. I also noticed that I had not left enough space to place the RFID reader below the center of the cardboard box, a mistake that I would not make in my final hardware design.



Figure 3. 18 Cardboard prototype with coins and Makey Makey

I then started making smaller wooden prototypes as a proof of concept for the final design. I tested out the magnets and the snap switches. I made the rings snap into place and close the circuit. I also tested the shape locking mechanism. I created different layers for giving height differences between the rings and realized the attention required to make all the layers work together smoothly. Figure 3.19 shows these smaller wooden prototypes.

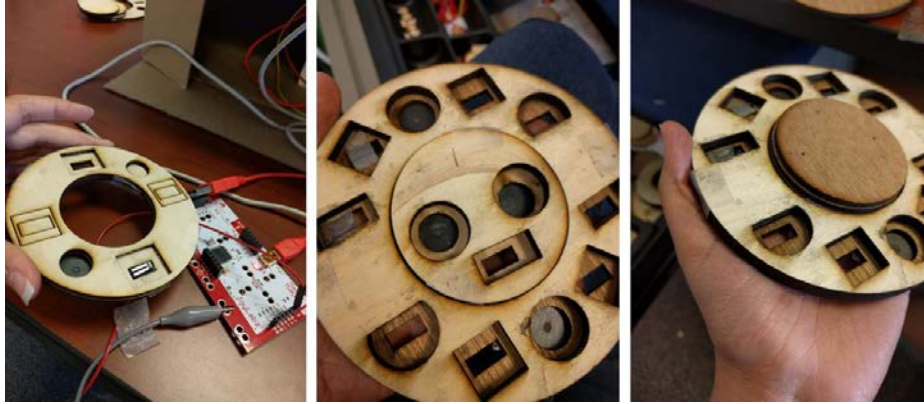


Figure 3. 19 Early wooden prototypes

The next step was to scale up my prototypes from 6 inches to 24 inches. I created templates on adobe illustrator and speculated where I might need more magnets to hold larger and heavier rings in place. Finally, the rings and the table top were laser cut and assembled.

3.3.4. Pilot Tests

After we made the installation space, I pilot tested the experience before running the study. I realized that it was important to introduce the concept of Rangolis to non-Indian participants before they started the experience, to give them context and understanding of the TUI (Chu et. al, 2015). I understood the importance of adding a tutorial before the actual experience, to acquaint the interactors with the working of the system. I did not want the novelty to hinder the storytelling experience, and hence the tutorial was key for building literacy to use the system. Another problem I identified was that at times, the lights would create a dark ambience in the tent which would hinder the readers from recognizing the colors of the assembled Rangoli. Thus, when the stories acknowledged the reader's Rangolis, they would not relate them to their own Rangolis as they could not see the colors of the rings clearly. I then changed the lighting effects to lighter colors. After three pilot tests, I was ready to run the study.

Chapter 4. Methods

In this section I describe the methods that I used in my study. I present my research questions, participant recruitment methods, protocol for the installation study, interviews, and methods for data analysis.

4.1. Research Questions

I attempt to answer four research questions with more emphasis on RQ1 and RQ2

RQ1: How do people interpret and interact with a narrative where they can craft the ambience of their space to impact the emotional and aesthetic context of the story, without changing the plot?

- What are the interpretive and interactive possibilities of a narrative when the ambience / mood is changing? What agency do people perceive over the system and how do they act with this agency?
- What role does the ambience play in the system? How do people engage with and perceive these ambient effects?
- How do people understand the working of the system? What is their interpretation of the system's working?
- How can we design interactive narratives that effectively give the reader agency over tone and mood of the story?

RQ2: How do people engage with diegetic interfaces in an interactive narrative?

- How do diegetic interfaces connect readers with the story world?
- How can we design diegetic interfaces that can support this connection?
- What roles do people adopt while interacting with the narrative?

RQ3: How do people perceive an interactive storytelling experience through a non-western cultural lens?

- What are their understandings and takeaways of the culture after the experience?
- Does the system spark more curiosity about the culture?

- How do they feel about being part of a new culture? How do people from the same (Indian) culture experience the system?

RQ4: Do people engage creatively with the story authoring platform? What motivates them to create?

4.2. Methods for Study

Participants were recruited through postings on Facebook, flyers in UCI campus, and through word of mouth. 25 study sessions were conducted in which 3 were pilot tests. The majority of participants were graduate and undergraduate students at UC Irvine. The table below represents the demographic data for the 21 participants that were considered for the study.

Table 4.1 Participant Demographic Data

PID	Age Range	Gender	Ethnicity/ Race/ Nationality
P1	18-24	F	Indian
P2	45-54	F	American
P3	25-34	M	Asian
P4	25-34	M	American
P5	18-24	M	Indian
P6	18-24	F	American
P7	18-24	F	American
P8	25-34	F	Asian
P9	18-24	M	American
P10	25-34	M	Indian
P11	25-34	F	Indian
P12	45-54	M	Indian
P13	18-24	M	American
P14	25-34	M	-
P15	25-34	F	Asian
P16	18-24	M	American
P17	35-44	M	American
P18	18-24	F	Asian
P19	25-34	M	Indian
P20	18-24	M	Indian
P21	25-34	M	American

Once participants volunteered for the study, they were contacted through email to setup a two-hour study session. These sessions were conducted in the Evoke lab at Calit2 at UCI. At the beginning of the session, participants were given a brief overview of

the study. They were introduced to the concept of Rangolis and they were told that the Rangoli they created would be created by the protagonist of the stories as well. They were then led inside the tent and were given an overview of basic interactions with the system such as placing and removing rings from the table top. They were asked to explore the demo version of the system for as long as they pleased. The demo version did not play the narratives but allowed readers to explore all ambient effects. During the demo, the system would call out the colors of the assembled Rangoli to help readers understand how the colors were read by the system. Once the readers were done exploring the demo, the narratives would begin to play. This experience lasted for 30-40 minutes. Participants were asked to think out loud and I sat outside the tent taking notes. After participants ended their experience, they were asked if they wished to contribute to the system by recording their own story ending. They were also given the option of listening to what others had recorded. Participants were given blank center pieces to decorate and record their stories. The center pieces left behind by other participants were placed outside the tent. Participants selected the pieces they wished to hear and took them inside the tent to listen.

Participants were then interviewed based on their experience. The interviews were audio recorded and lasted for 30-60 minutes. The semi-structured questions were divided into several parts based on the research agenda. Participants were asked about their comprehension of the stories, and their engagement and motivations for interaction. They were asked to elaborate on their mental model of the system and the interaction. They were asked questions specifically related to ambience and moods. Participants elaborated their decision-making process of selecting Rangoli rings and crafting ambiances. They discussed the connection they developed with the characters and their perceived role in the experience. Participants were asked to elaborate on their experience with the cultural interface. They explained their motivation for story authoring and listening to other recordings. The interview was concluded by asking participants for feedback and different use cases of the system.

I transcribed 23 interviews and analyzed the data for 21 participants. Out of the 25 sessions, two pilot tests and 2 participant's data were excluded from analysis due to complete lack of story coherence and system understanding. The third pilot test's results were analyzed as there was no difference in the protocol used in the study and the protocol used in that pilot test. I conducted an open qualitative analysis of the interview

transcripts and the notes taken during the session. I had also used log data of their interaction with the system for reference. I used a bottom-up coding approach to analyze the data. I conducted the first round of coding on the transcripts and notes to identify various codes. I organized these codes based on the research questions. I then conducted the second round of coding and categorized certain codes together and put them under broader thematic codes. These second level codes were then grouped together to identify different themes. I then used my second level of codes and themes to visualize the data on a whiteboard with sticky notes, as shown in figure 4.1. I made meaningful connections between the themes and analyzed my findings and answer my research questions.



Figure 4.1 Visualization of themes

Chapter 5. Findings

In this chapter I elaborate on my findings based on the interviews. This chapter is divided into six sections – role of ambience, different interaction styles, roles and diegetic connections, design of the system, cultural findings, and creating story endings.

5.1. Ambience

In this section I will focus on the role that the ambiances played for the readers, and the different ways in which ambiances were perceived and interpreted.

Ambience as diegetic

Readers felt as if they were positioned inside the story world because of the environment created by the ambience inside the tent. The lights, sound, music, and visuals helped them place themselves in the story world. Some readers tried to recreate the ambience of the story world as they wished to put themselves in the character's shoes. Readers claimed that they were more immersed in the experience when the plot of the story and the ambience they had created were in sync, as it helped them experience the story world. Ambiences also helped to set up a mood and tone for the story, and hence readers could connect with how the characters were feeling. Due to this connection, some readers also felt as if they had transformed into God Shiva himself. These findings suggest that in this experience, ambiances played a diegetic role as they simultaneously existed and impacted the environmental aesthetics of the reader's world and the fictional world, successfully transforming the reader's space into the story world. Through the Rangolis, readers could influence the ambience of their own space which would in turn impact Shiva's mood, emotions, and the ambient space of the story world. Hence, not only did the Rangolis play a diegetic role, the ambiances also helped transform the physical space to connect the reader to the fictional world.

P19: "The accompanying visuals and the sound of the river gave me the feeling that I was part of the story and was right next to the river. The thunder and sounds of the river with the visual of the waves helped in connecting me to the situation."

P06: "I was able to picture everything and having those things in the background, almost it was like I was there also, like I was in the background just watching it all play out. Watching the stories."

Ambiences set a focused and solitary space

Readers felt that ambiances helped them focus more on the narrative. The ambience connected readers to the story world, hence the environment acted as an aid to the auditory narrative and improved story coherence. Ambiences helped readers block out the rest of the world outside the tent, hence creating a solitary space that they could call their own. The ambient effects also helped drown down noisy distractions from outside the tent. Some readers were able to create a calm, relaxed and focused space for themselves. This finding is particularly helpful as many interactive auditory narratives have a difficult time keeping the reader's attention and hence readers lose narrative coherence.

P06: "I kind of pictured it in mind, this is where it is heading. if I like closed my eyes, that's what I would see and the things that I would hear in the background. It helped me understand the stories a lot more than if I were just sitting down and listening to it."

P18: "I thought it was more a means of affording privacy, blocking out the rest of the world."

P13: "There was a bit of noise/volume that happened in rest of the room but that was less noticeable when all three rings were in place and the center piece was going. I was able to focus on how things were going and the tent helped drown things out a little bit."

Ambiences help see different perspectives

The ambiances set different moods and highlighted certain emotions in the narratives. The narrator's voice and slight change in the story's text also enhanced the mood created by the reader. The ambiances helped readers see different perspectives of the story, perspectives that they would have not seen had they heard the stories outside this context. At times, the ambiances changed the feelings associated with certain events as they put the readers in different moods.

P10: "As things changed, your internal attitude towards the story changed. I experienced some form of correlation."

P16: "I felt like it changed how I interpreted the story. Specially with the way the narrator was talking. So it would put me in a mood, even if the stories didn't perfectly reflect that mood, it changed the story so that it would fit the mood that I was making and changed my perception of the story."

Some readers extended their interpretation of the ending based on the ambience created. For example, one reader claimed that the ending of the story 'the river' seemed hopeful for a new beginning despite the destruction, as the ambience was calm and uplifting. One reader interacted with both the stories twice, and justified the endings very differently each time, based on Shiva's emotions and the intent behind his actions. Hence, the ambience gave the agency to interpret the stories in different ways due to the changing tone of the story, Shiva's mood and reactions, and the mood of the space inside the tent. The ambience control and narrative also helped readers interpret Shiva's character in different ways, as he was perceived differently because of the changes in the emotional tone of his dialogues.

P17: "The music and visuals were very nice, but the ending was pretty tragic (for 'the river'). Hopeful for a good beginning."

P05: "In the first one it was more of a hopeful ending as Vayu was able to cure all the villagers, in the second one it was a very bad ending, that was what I was trying to go for that Vayu wasn't able to cure the villagers and his sin just haunted him to his grave."

P17: "Shiva can get in really bad moods, but it ended with him in a good or even forgiving mood."

Readers also felt that ambiances helped to enhance or diminish a certain feeling associated with the events of the stories. When the ambient space and the story were in sync, the feeling associated with the plot was enhanced. Similarly, the mood setting also diminished feelings or the extent of severity of certain events. For example, a happy ambience made during the end of the story 'the river', decreased the harsh feeling accompanying the destruction, and helped readers see the light in the destructive story ending. In this particular example, the reader diminished the mood associated with the plot and found more meaning in the story ending. Hence, I infer that ambiances and affective dialogues can help perceive both good and bad events as better or worse. However, the ambience does not completely change the emotional response associated with a particular event. The data suggests that the emotional interpretation of a story is based on the events, the character's perspective that one sees, and the narrative arc. The accompanied ambience can only drive the extent of this emotion.

P17: "But if you feared the way things were going, you could offset some of that by making things a little more pleasant." Regardless of what was going on, if the person wanted to calm the story down they

could do that using the Rangoli. If they wanted it to be forceful, aggressive, they could use the Rangoli for that."

P01: "The climax of Jhanvi rising and the red lights and thunder, it felt real. I had goosebumps at times. I could actually feel it."

P20: "If I created a very chaotic ambience and I had to tell someone something really bad, I feel like they would end up more angry than if I were to create a happy pleasant peaceful experience and if I tell them something bad, they would shake it off."

I also infer that the open-ended story 'the medicine' gave more agency of interpretation than the close ended story 'the river'. However, I do not claim that the ambiances helped in guiding their interpretation of the open ending as there were other factors such as desire for a happy conclusion, their connection with the character, and their understanding.

Ambiences bring about emotional responses

Ambiences helped set up a space that put readers in a particular mood. They also had an emotional response to the ambience. One reader felt that even if the story plot was different, he would feel the emotion that the ambience created. These feelings helped readers see different perspectives of the stories.

P20: "I feel like if I used more red (rings – light, sound, and music) I would get more of a little bit angry feeling like 'how could they do this.' If I did green all the way through I would get a nice peaceful fable that someone would tell, that you would listen and just be happy listening to it."

P06: "The first time I put the red one down it started flashing, I kind of got scared I think I jumped a little bit. I also really liked the green (rings - light, sound, and music) one as it was really calming, it gave me a chance to breath and listen to the story."

P20: "I like the green (rings- light, sound, and music) is very calm, even though they were fighting, I still remain calm."

Ambience gave a sense of responsibility and meaningful action

In this particular context, ambiances gave a sense of responsibility and encouraged the reader to act meaningfully as they were concerned for the outcome of their actions. Readers felt responsible for the direction of the story and the characters which immersed them more in the story. This sense of responsibility may be attributed to the diegetic Rangoli as well, which I will further elaborate in the sections below.

P03: "Later I realized that what I chose affected these people. In the first half I connected with these people and cared about them. That made me think how my choices effected and if I should change my choices."

Ambiences perceived as continuous emotional entities

Readers perceived the ambience to give incremental and gradual changes in the mood and tone setting. For example, they believed that the effect of three red (angry) Rangoli rings on the ambience and the story would be worse than the effect of two red (angry rings) alongside one yellow (happy) or green (calm) ring. However, the system did not cater to this thought, as overall narrative options were only binary (positive valence or negative valence). Moreover, the setting of the ambience itself was discrete, each ring controlled one aspect of the ambience (sound, music, or light) where each ring could reflect only one emotion, rather than the entire ambience reflecting varying intensities of a particular emotion. One reader found different colored rings created distracting environments and preferred to create the Rangoli with the same colored rings for setting a harmonious ambience. Readers also felt that the ambiances created could be interpreted as a mix of different emotions rather than perceiving them as dominantly setting one mood. They used colors of the Rangoli to balance out emotions and express varying intensities of emotions.

P02: "I could influence how angry someone was, I didn't want to put all red up there, I did not want to see what would happen. I thought the system might show me if I did."

P13: "I added more red, blue to give it some negative sense as Shiva's good mood starts to be soured. I think I left a little yellow as it's (happy mood) not completely gone."

Interpretation of ambiances change over the course of the story

Readers associated different meanings with ambiances over the course of the story. For example, the angry ambience did not always serve as a tense and stressful environment. The meaning was highly situated within the context of the story. One reader claimed that towards the end of the story 'the river', the ambience was very tense and aggressive, however she did not join in on this feeling, as she felt calm since justice was being served in the story. Some readers mapped the ambience to meaningful semantics in extension to the emotions, such as chaos and peace.

P08: "There was a part with rolling water (stormy) it is supposed to be rough and angry, but to me in that moment it felt calming to the extent that it felt like justice was being served. This was meant to happen because you (the character) are being a jerk."

People feel compelled to change the ambience

After every chapter, readers felt the need to change at least one ring in the Rangoli, keeping the experience engaging and interactive. This is because readers were keen to match the ambience to the story plot as they did not want to break immersion. They were also motivated to match the ambience to Shiva's mood and make meaning from the tone and mood setting. A few readers were curious to see different effects of the ambience on the narratives. These findings have been elaborated in further sections.

5.2. Interaction Styles

In this section, I explain the three types of interaction styles that were observed during the study as people engaged with ambiances and the emotional context of the narrative: story supporters - readers who supported the story by matching the ambience to the plot; story controllers – readers who asserted some amount of control on the story through the ambiances; and meaning makers – readers who made different meanings and saw diverse perspectives through ambiances. These models are not mutually exclusive as people took on different roles as the experience progressed. There were eleven readers who interacted as meaning makers, ten interacted as story supporters and seven interacted as story controllers at various points during the interaction.

Story Supporters: predicting what happens next

Readers played as 'story supporters' when they felt that they had no agency over the story plot, story tone or the characters. They believed that the stories were completely pre-scripted and would not change, even in their emotional tone. Hence, they interacted with the system by creating ambiances that matched the story's perceivably pre-written plot. They were motivated to match the story and the ambience as it helped in immersion and any defiance would break this immersion and cause disruption. Furthermore, they held themselves responsible for any mismatch between the ambience and the story's content and felt accountable for the break in immersion. Readers would predict what would happen in the next chapter of the story, based on what they had just heard in the previous chapter, and they would set an ambience to support the emotional

context of their prediction. For example, if they predicted chaos and destruction in the next chapter, they would use the red (angry) rings to create a supportive ambience. Readers would predict and follow the natural arc of the story and made ambiances to match the story's tone. Some readers set the ambience such that it would support the previous and the next chapter. A few emphasized that their ambiances were created to support 'their' predictions rather than predicting the story based on the author's plot. One reader tried to re-create the character's environment as told in story (night / day) in order to put themselves in the character's shoes. An extreme example of supporting the story was seen when two readers used the same colors that were hinted in the story, even though the colors called out in the narrative reflected their own Rangoli. One reader created ambiances to support their perception of the character's personality or to mimic the character's mood. They would place red rings for Shiva's dialogues as Shiva was the God of destruction who was best supported by the red (angry) ambience.

P02: "It's almost like a play where I am the setting or the backdrops or stage hand. You just foretold that there is going to be an argument. Now I need to change the mood because I need to support the story since that is where the story is going."

P06: "I was more engaged in trying to figure that and trying to match it to the story and trying to predict what was going to happen, so I could put the right rings down for the environment. I kind of already figured that the stories were already there, so I just tried to play along with it."

P17: "That's funny I am trying to predict the way it's going, but it's going the way I tell it to go."

P07: "Depending on what she (the narrator) was saying and what was happening I would change it accordingly to as what would come next, or what I hoped to come next. As the person tells the story you have to predict what will happen next, so you change the mood of the environment."

P17: "I thought if a sunny day was coming I would want the yellow lights and if it was by the river, I would use the river sounds."

I speculate the reasons for this interaction behavior. These readers believed they had no autonomy as they met a few occurrences where there was a major mismatch between the ambience and the story content. This led them to think that the story was completely unchangeable and hence they matched the ambience to support the story. There were a few people who felt overwhelmed by the interaction or were distracted (elaborated in further sections). They did not perceive a connect between the Rangoli

and the ambience setting an emotional context / Shiva's mood. A few of these people did not feel that the Rangoli was diegetic as they did not notice the cues in the narrative that acknowledged the colors they had used in their Rangoli. Some readers assumed that the story was pre-scripted as there were too many possible combinations for the Rangoli, making the task of branching narratives extremely cumbersome. A few people felt that major events in the stories had their own arc, the stories were well established mythological tales, and only slight changes in the tone were possible. A few felt responsible for matching the ambience to the story plot which guided their behavior.

However, even the people who strictly felt that they had no control over the pre-written story perceived that they may have directed the outcome at the end. I believe this resulted from the fact that towards the end of the stories, the narratives warned the readers that their next Rangoli would have an impactful consequence as opposed to earlier chapters where the Rangoli colors were acknowledged in the narrative only after readers had created the Rangoli (this difference is explained in [Chapter 3](#)). I elaborate on this finding in further sections.

Story Controllers: Felt some degree of control over plot

Some readers felt they had control over the story's plot at key points during the narrative. These key points were perceived when a reader's Rangoli was acknowledged in the narrative. Many people felt that there was a branching narrative towards the end, due to the narrative warning the readers of the impact of their next Rangoli. Readers felt that they controlled the character's actions and fate as they created ambiances to make Shiva behave in certain ways. Some felt they projected their own mood on the characters by making ambiances that reflected their current moods. An extreme example of the 'story controller' behavior was when one reader felt they had control over each chapter and the narrative arc as they used the Rangoli to drive the narrative. One reader acknowledged that although she did not know to what degree she controlled the story, yet she acted as if she had full control over the story in order to direct the next segment.

P18: "I thought Shiva would take the entire river and be like alright we are going to wipe everything clean. I was hoping for blank slate, and that happened. That's why I was clapping the whole time, I was like yes excellent. Killing off the humans was just a bonus."

P16: "Every time it (story) acknowledged me, I felt like I had accomplished something or changed the narrative."

P19: "There were some places – for instance in the first story, the chapter ended with Shiva making a Rangoli, and Brahma and Vishnu would see the Rangoli to understand his mood. I think that's when I got a choice to make the Rangoli and that's how the story would progress. In the first story, I made the choice of Shiva being angry with the human race and he started doing the Tandava. I went with all red then. But if I had gone with something soothing, since Vishnu also was saying that it was his mistake and he would have to fix it. I am not sure but maybe there can be a different choice there."

Readers felt in control of the story when the narrative acknowledged their Rangoli and specified the impact of the selected colors. This acknowledgment helped them become more attentive. Readers also felt a sense of responsibility towards the character and story outcome, which further guided this interaction style. People felt more in control when the ambience matched the plot of the story. Furthermore, they also felt in control when their expectation of the narrative matched the outcome of their choices, especially when these outcomes were impactful such as the end of the human race in the story 'the river' (even though the outcomes were the same). The Rangoli interface helped readers transform into Shiva, a finding that I elaborate on in further sections. The narrative cue in the ending of the stories that acknowledged the Rangoli before its creation was more powerful than the other narrative cues that acknowledged the Rangoli after it had been created. This is because, in the former the readers were warned of their actions and the impact of the consequence. Two readers felt that they transformed into Shiva in this very moment. A less observed possibility that guided this interaction was the misconception of branching narratives that was not mitigated during the entire interaction.

P18: "I think the more important ones that change the direction of the story are a few at the end."

P21: "I felt like the reference to the Rangoli in the story prompted me to think more about it. And it went in the direction that I had created with the Rangoli, the happy ending in the second story and the uncertain ending in the first story were in line with my choices."

P18: "At the very end of both of them, they would remind us that (Rangoli), for example the other Gods would look at the Rangoli Shiva is creating and I would know this next one would determine the fate of the story, where Vayu would look up and say this Rangoli will be his fate. In the first story at the end, I remember feeling oh yes I am Shiva, representing his emotions and that connected me the most because it

was like I am in the story, it's like I am controlling the story but I is also reflective of God Shiva."

A few negative effects of the 'story controller' interaction were observed. One reader's ultimate goal was to end the narrative on a happy note. Hence, she created only positive ambiances, fearing that any negative ambience might end the narrative in a darker tone. Although I consider her choice of not changing the Rangoli rings as an intentional form of inaction as she was committed to creating a happy ending (Tanenbaum, 2015), yet this curbed the independence of exploration, exploring the narrative arc, changing moods, and making meaningful choices. Some readers were overwhelmed by the system as they had to simultaneously listen to the stories, map the ambience with the mood, predict the narrative, and drive the outcome. Hence, they were unable to understand the system completely. They were aware that they were impacting the system but did not understand how their choices were impactful. This curbed the possibility of making meaningful choices.

Meaning Makers: Agency of mood, tone, and perception

In this interaction style, readers felt they had agency over the mood, tone, and pace of the story. They felt they could change the tone and pace of the story through the ambiances, and found meaning in these choices, without changing the story plot. The ambient and emotional setting helped them see the story through different perspectives. The ambience also put readers in certain moods that changed their perception and feel towards certain story events. Participants could feel where the story was heading based on the emotional tone of the ambient space. Readers felt they had the agency to interpret the ending in different ways based on the emotional tone that they set. As described earlier, one reader interacted with both the stories twice, and justified the endings very differently each time, based on Shiva's emotions and intent behind his actions, even though the ending outcomes were the same. As described above, readers used ambiances to enhance or diminish the feelings associated with certain plot elements, yet the emotion attached to a certain event was based on the content of the story and not the ambience. They would also change the ambience to impact Shiva or the river's moods, feelings, and the emotional / ambient state of the story world. Readers felt that they could personalize the story just by affecting the mood of the character, without changing the content. Some people used their own emotions to describe how Shiva would feel, some supported how they thought Shiva himself would feel, some tried

to place themselves in his situation and acted accordingly, some transformed into Shiva as there was no distinction between their moods and his, and a few predicted Shiva's actions (rather than emotions) and interacted accordingly.

P13: "I felt because I had influence the mood of the character, even though it didn't influence the progression, I felt like I was be able to tell my own story of his emotional ups and downs and that felt powerful to me, I very much enjoyed that specific section."

P05: "I mostly went with the story and the content of the story. If Vayu lied and continued to use medicines for greed twice, that made me angry and disappointed in him so I just acted accordingly by expressing my anger and disappointment with red and blue. In Shiva's story just like Shiva I was annoyed with Brahma and Vishnu that they were complaining so much even though it was just me doing my job. Again, I portrayed that with anger and sadness through the Rangoli."

P13: "I feel it is lot like being the director of the show because the director doesn't write the script. But the director sets the tone, ambience, what it looks and feels like."

I speculate this interaction style was observed because ambiances helped shape the reader's mood and evoke emotional responses. This emotional setting helped readers see different perspectives and guided the interaction style. Besides the ambience, the change in narrator's voice helped set an emotional context. Readers also acknowledged that the story was written in a way that could be interpreted in different emotional contexts and seen from different perspectives. Readers felt they had very less to no control over the story plot but could impact the mood and tone of the story. They felt that the major events and narrative arc of the stories were pre-written. Some readers felt that the story had to be fixed as there were too many possible combinations for the Rangoli, making the task of branching narratives extremely cumbersome. Certain mismatches in the emotional context of the ambience and plot also helped readers conclude that they had less agency over the plot.

P13: "I could throw in yellow after Shiva destroyed humanity. Even then you could interpreted that in different ways. You could say Shiva is relieved that he is done with mess as others pick up the pieces. You had enough room to interpret even if things were completely contrasting."

P05: "I think the whole concept of Shiva's mood being reflected in the Rangoli which in turn effects the world. More than the story, emotion basically drives the story is my take on it. I find it very fascinating and necessary how emotional constructs and crafts shape how story is told, and not just in a content-based sense."

P02: "I have some control based on my decisions but in the end it really out of my control, it's the Gods."

Changing between different Interaction Styles

Readers shifted between different interaction styles during the interaction. This shift would be more prominent when the mismatch between the ambience and the plot helped people realize the agency they had over the system and when they would understand how the system worked. Figure 5.1 shows the interaction style of P02. P02 started with the assumption of being able to control the plot which was removed due to the mismatch in the ambience and the plot. P02 switched between acting as meaning maker and story supporter based on when Shiva was present in the story and when he was not respectively.

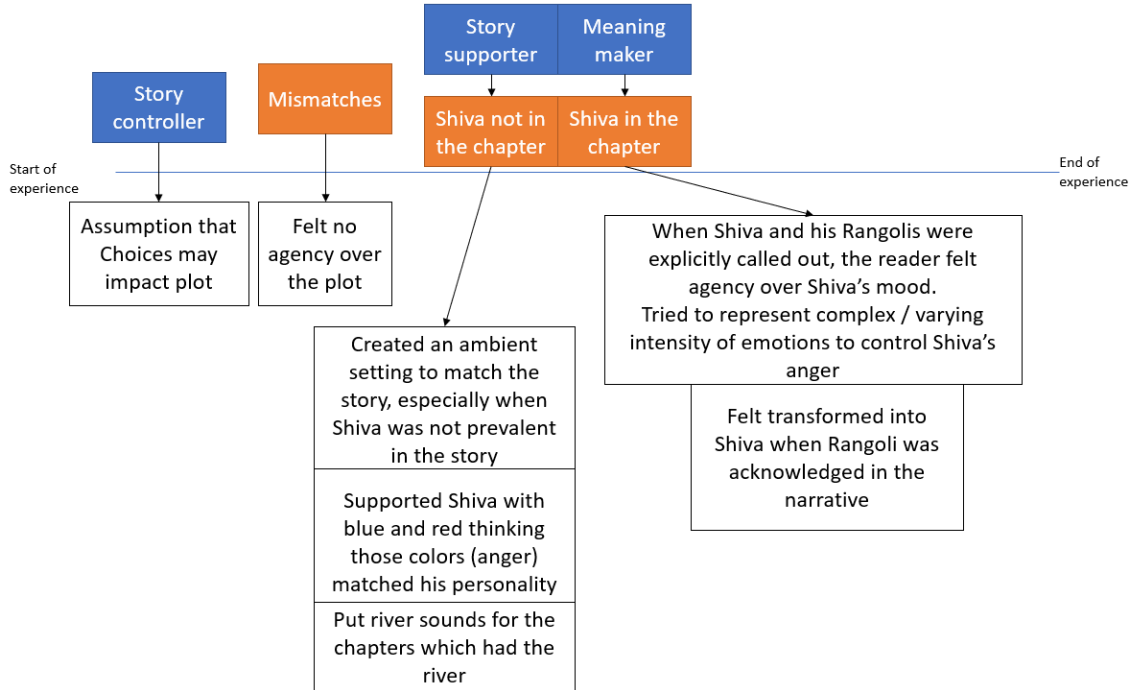


Figure 5.1 P02's interaction style timeline

Figure 5.2 represents the interaction style of P18. P18 shifted between meaning maker and story controller. They felt in control of the story plot towards the end of both stories when they were warned of the impacts of the next Rangoli. The mismatch in the ambience and plot helped them realize the agency they had over the story. Throughout the interaction, P18 was aware they could impact Shiva's mood and tone of the narrative, however they felt they asserted some control over the story at key point.

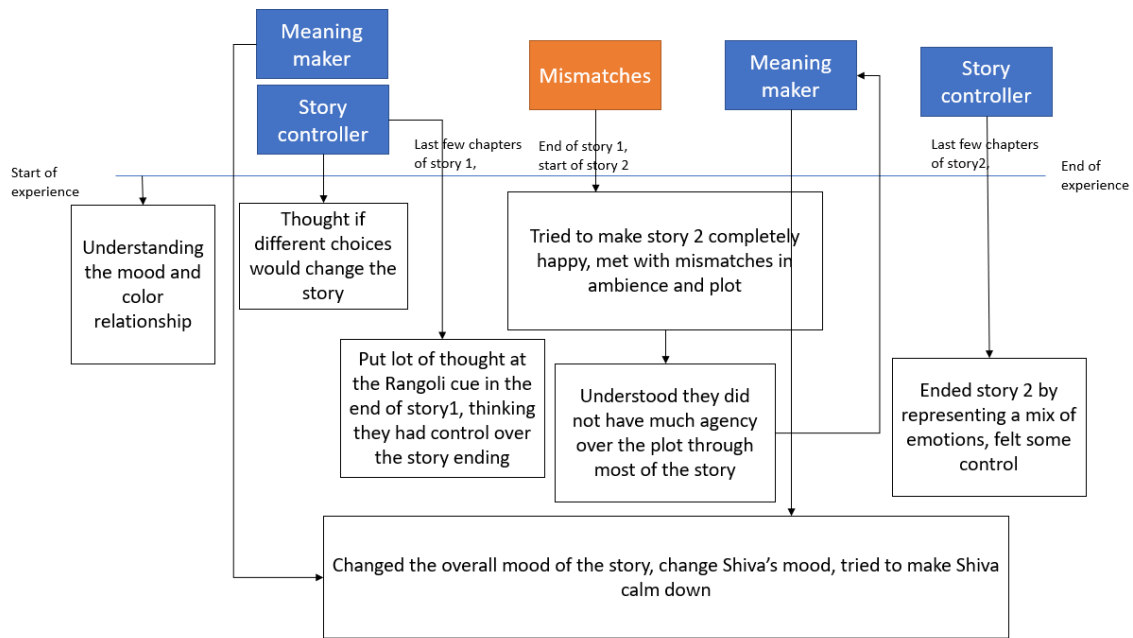


Figure 5. 2 P18's interaction style

Balancing goals while creating ambiances

Readers created ambiances to support the narrative or/and to support their personal preferences. Most readers were committed to making ambiances that fit well with the narrative, rather than creating the ambience just for themselves, just for exploring, or causing disruption by deliberate mismatches. They felt a sense of responsibility towards the characters and chose to serve the story over their choice of aesthetics for the Rangoli, their favorite colors, or what they wanted the ambience to be. Even with all these goals, serving the narrative came first.

P18: "My main goal was to hear a good happy nice story but that didn't come out until after I realized that my desire to have these characters have a good story was greater than my desire to troll around. Else I would have done all blue as that is my favorite color."

P03: "Then I went into narrative I gravitated towards how I want Shiva to feel. That's when my experience of the Rangolis truly connected with the narratives and made it more of serving the narrative more than serving myself."

Some readers created ambiances that mimicked their own moods. They created moods for themselves and projected their feelings on to the characters. One reader created ambiances that reflected their own personality. Readers wanted to create a comfortable listening space. Sometimes, people would choose their favorites colors for

the Rangoli, favor aesthetics, or select random rings to proceed. This generally occurred when people felt they had no agency or had less understanding of the system.

Three people balanced out both goals of creating ambiences to serve the narrative and themselves. They switched between these two goals through assembling Rangolis that served different purposes during different chapters, or by assembling rings that each served different purposes within one Rangoli. For example, one reader used a calming music throughout but changed the other two rings to set an ambience that supported the story.

I also observed that the red lights were uncomfortable for people. For them, removing this discomfort was of utmost importance and the goal of supporting the narrative would come only after this discomfort was taken care of.

Summary of interaction Styles

Readers switched between multiple interaction styles as the experience progressed. Table 5.1 summarizes the three interaction styles, agency felt, reasons for this perception, and an approximate number of participants that experienced the interaction style.

Table 5. 1 Interaction Style Summary

Interaction Style	Agency	Actions taken	Reasons	Approximate number of participants
Story Supporters	No agency over the story	Predicted the story and matched the story's perceivably pre-written plot	Did not want to break immersion, mismatches in story and ambience, overwhelmed	7
Story Controllers	Controlled the story plot at key points	Felt they made choices when the narrative called out their actions	Felt responsible for character's fate, Felt in control when the narrative acknowledged their Rangoli	10
Meaning Makers	Agency over the tone, pace, and mood of the story but not the plot	Changed Shiva and Jhanvi's mood and tone and connected with their feelings through ambiances	Mismatches in story and ambience helped them realize the agency they had, saw different perspectives of the narrative	11

5.3. Roles and Diegetic Connections

In this section I discuss the findings on how people connected with the characters of the story (predominantly Shiva), what roles they saw themselves take during the interaction, and how the ambience and Rangoli acted as diegetic objects.

5.3.1. Roles

In this section I describe the different roles that people took while they interacted with the story.

Connected to Shiva

Readers connected to Shiva in different ways. Five readers transformed into Shiva at some point of the interaction as they talked and acted like him. One participant completely transformed into Shiva as he felt and reflected the way Shiva would have felt in the stories. A few tried to place themselves in his situation and acted accordingly. The ambiances helped to amplify this emotional connect. One reader mentioned how the act of making Rangolis made her feel like she was Shiva. These findings support Tanenbaum's (2015) design poetics that suggest transformation is more likely to occur when the character's and player's emotions are in sync, and when players enact the character's actions. I also speculate that readers who completely transformed into Shiva were more accepting of Shiva's personality as represented in the stories. Five other readers felt as if they were a part of Shiva rather than Shiva himself. They felt like a part of his personality, a tool for expressing his emotions, or like a person sitting in his mind. Readers felt emotionally connected with Shiva as they would try to assess his mood or place themselves in his situation and act accordingly.

P05: "I felt like I was the almighty, I was determining life and death. I had the responsibility not only to destroy but also overlook Vishnu and Brahma's jobs. I felt very powerful, I had this huge responsibility and I had to act more mature and more calm in order to live up to that role."

P05: "I was Shiva in that tent. I felt this sense of responsibility and I just took on the role of the destroyer. I was like the embodiment of him, just acting according to my emotions and will that in turn became Shiva's emotion and will."

P02: "At one point I felt like I am Shiva. He makes Rangolis and I am sitting here making Rangolis and I thought can he make an all yellow one and I did it, he did it, and it said it was beautiful. In that moment I felt embodied."

P18: "We were creating the Rangolis he (Shiva) was supposed to be creating so we were kind of controlling his mind."

P19: It felt similar to the movie "Inside Out" where you are giving emotions to Shiva and he is behaving accordingly using the Rangoli. It felt like you are sitting in Shiva's mind and driving his mood.

Part of the story

Six readers did not connect to Shiva particularly, yet they felt that they were a part of the story. A few felt as if they were the God above the Gods or another powerful

God in the story as they could control Shiva's emotions and actions. A few felt as if they were in the story world, but as observers, and did not relate to any of the characters.

P15: "I felt like another God who was making the environment for Vishnu and Shiva to fight. I was setting up this stage for them to fight."

P01: "(I felt) Like a person in that era or a person in that story. Not like I am Shiva. I felt like I was there closely watching what was unfolding in front of me. Like someone in that world."

Detached yet contributing

Around nine people did not explicitly feel as if they were a part of the story, yet they were active engagers. A few felt that their role was to responsibly decide the fate of the characters in the story. One reader felt as if she were directing a play by deciding the tone and feel of the story but had no agency over the script. Some readers felt that their role was to create an immersive experience for themselves.

Passive

Three readers took on a passive role as they felt as listeners or observers in this experience. One reader felt that his role was to map out and understand the working of the system.

Changing Roles

These roles were not mutually exclusive as people took on different roles during the course of the interaction. This role shift was observed once the literacy for using the system was developed, as people would shift from being explorers (passive) to active engagers. Role shifts were also observed between the two stories as 'the river' placed Shiva as the central character, allowing readers to take a more active role. One reader mentioned her dilemma between interacting with Shiva and transforming into Shiva. Table 5.2 represents the different roles people undertook.

Table 5. 2 Roles that readers took

Roles	Number of people
Shiva	5
Part of Shiva	5
Part of the story, but not Shiva	6
Not in the story, but took active roles in the experience	9
Passive listeners	3

5.3.2. Diegetic Rangoli and Ambiences

In this section I explain the diegetic nature of the Rangoli interface and the ambiances. The ambience was in the background of the interaction, it helped readers connect emotionally with the story and placed them in an environment that reflected the story world. The Rangoli interface was in the foreground of interaction and helped readers take certain actions that they wished to see the outcomes of in the story.

The Rangoli interface was diegetic as the Rangolis created by Shiva in the stories were the same Rangolis that the readers created in the tent. These Rangolis would reflect Shiva's mood which would shape the ambience of the story world as well as the reader's world, making the ambience diegetic as well.

Diegetic Rangoli Interface

Readers could take certain actions by creating Rangolis and see the outcomes of these actions in the story world. Readers transformed into Shiva or felt more connected with Shiva and the narrative, when the color of their Rangolis matched the Rangolis that Shiva created in the stories. This acknowledgement of their Rangolis led to reflection, focus and reminding readers of the purpose of the interface.

P02: "At one point I felt like I am Shiva. He makes Rangolis and I am sitting here making Rangolis and I thought can he make an all yellow one and I did it, he did it and it said it was beautiful. In that moment I felt embodied."

Many readers felt immersed when there was a noticeable consequence in the stories because of their Rangoli and when the Rangoli impacted Shiva's actions. One reader felt more engaged when he saw the conversation between the Gods turning sour because of the way he changed Shiva's mood.

P13: "My favorite moment was when I decided to give it a yellow more joyous feeling, even though yellow wasn't my favorite, that added to the story that Shiva was in a good mood today, so Brahma and Vishnu decided this was a better time than otherwise to confront him. I felt alright, how do I think that may turn out. I added more red, blue to give it some negative sense as Shiva's good mood starts to be soured. Seeing that respond to Shiva darkening a bit as this more annoying conversation was happening."

As mentioned previously, the acknowledgement of the Rangoli towards the end of the stories was more powerful as readers were warned of the impactful consequences of their next Rangoli (before their actions), as compared to previous segments where the Rangoli colors were acknowledged and the consequences of the choices were revealed only after the reader had created the Rangoli (after their actions). In the former, an illusion of impact of choice had been created through the warning and was followed through with the climax of the narrative. This brought the reader's attention to the Rangoli and their choices, helped readers reflect on Shiva's emotions, and aided a few readers to transform into Shiva himself. For some, this acknowledgment of the Rangoli at the end changed their role from an observer to an active contributor. Four readers felt they had affected the story plot through their decision. Because of these reasons, the diegetic nature of the Rangoli guided the interaction style of the 'story controllers'.

Many readers felt immersed due to the act of Rangoli making and the diegetic nature of the interface. They used the interface to connect with Shiva's emotions. Moreover, since their action of making Rangolis mapped into the story world, they felt more responsible and connected. One reader mentioned how he literally and metaphorically 'shaped' the story through the Rangolis.

The diegetic nature of the interface helped people map out the working of the system. The acknowledgment of the Rangolis in the stories and the consequences that followed, the interface setting an ambience and an emotional context, and the affirmation of expectations of where the narrative was heading because of the Rangolis, all helped in connecting the Rangoli interface to certain moods, tones, and Shiva's emotion. This helped people develop a literacy and act meaningfully.

P03: "Mainly when I hear that Rangolis would determine Shiva's mood. It's not a subtle hint. Hearing that you get clued in. In beginning they say how his mood is brought out in the Rangoli. They talk about how Vishnu and brahma are nervous around him they wanted to see his

Rangoli first. That build up was nice and at the crucial point it clued me in to pick the ending I want.”

Readers also mentioned that the Rangoli interface fit well with the story context, which in turn gave a more immersive experience. They felt that the interface was more impactful than traditional interfaces such as controllers or screens and appreciated its diegetic nature.

Ambience as diegetic

The diegetic nature of the ambiances helped in evoking emotional responses. As explained previously, the ambiances put the readers inside the story world as they shaped the reader's space to reflect the state of the story world. The ambiances helped readers connect emotionally with Shiva and the stories. Around three readers transformed into Shiva by connecting with him through the emotional context that the ambience set. They felt how they thought Shiva would have felt in a particular situation. Readers were engaged when Shiva or Jhanvi reflected the emotions that they had created or they themselves were feeling.

Consequences of interactions with diegetic interfaces

Readers wanted to support the characters through the Rangoli because of the connection they developed due to the ambiances, the Rangoli interface, and the role they saw themselves play. They supported Shiva by creating Rangolis that would reflect his emotions in a situation. One reader transformed into Shiva such that she would instinctively use red and blue colors in her Rangoli to reflect Shiva's temperament. Readers felt a sense of responsibility towards the story and the characters, which compelled them to change the Rangolis after every chapter to meaningfully engage with the narrative. Story controllers felt in control of the story because of the diegetic interface. I believe that readers established a deeper connection with the narrative because of the diegetic nature of the ambiances and Rangoli interface.

One reader acknowledged how he became more aware of his own emotions after the experience. He felt that he should act calmer in certain situations and be more aware of his actions.

P05: "The whole ambience and setting and immersion gave me like (I was taking role of Shiva) even now I have this responsibility that I am taking to act according to what is good and righteous instead of my own lust or greed."

Two readers felt engaged in the art form of Rangoli making due to the interface and termed it as a 'creative experience'.

5.3.3. Limitations of Connection with Characters

Despite the diegetic interfaces, nearly half of the readers did not transform into Shiva, nor did they connect with him. Based on the interviews, I speculate multiple reasons for this. Shiva was not predominantly present in the second story, 'the medicine', which may have caused a confusion in the role that readers were supposed to take. In both the narratives, Shiva was the God of destruction and had a very strong personality. Readers could influence his mood but could not change his character, as Shiva always remained true to his persona. A few readers did not connect with his personality and felt detached due to his status as a God. Some readers saw him in a negative role due to the negative connotation that the word 'destruction' carries. They did not agree with his actions and hence could not connect with him.

I also observed that people connected with characters due to the content of the story and not just through diegetic interfaces. They connected with characters based on who they felt the protagonist was, the story line, personal connects that they felt from their own lives, concern for characters, a character's role in story, and existing mythological knowledge.

Around three readers acknowledged that they were overwhelmed by the system. They felt there were too many tasks that had to be done simultaneously - listening to the stories, acting according to their interaction style, and mapping the interface to the moods and ambiances. They took a more passive role and did not connect with the characters as they were not able to understand the working of the system completely. Some readers missed the diegetic nature of the Rangoli, or the mapping of the ambiances to the moods, or the narrative coherence.

5.4. Design

In this section I discuss the findings that are specifically related to the design of the system. I explain the novelty effect of the system, what helped people understand the system, mismatches, and misconceptions of the system.

5.4.1. Novelty Effect

The installation experience, stories, and interface all were completely new to the readers. Hence, it had a certain novelty effect. However, the experience was 30-60 minutes long, which wore down the novelty effect to some extent. I will elaborate further on the findings related to the novelty of the system.

Exploration to Informed Decision

The readers developed an understanding of the system over their course of interaction. During the first half (generally the first story) readers would explore the system, understand the mapping of the ambiances, interface, and moods, and use their favorite colors on the Rangoli interface. They would generally gain a complete understanding after they went through one of the stories. The acknowledgement of their Rangoli colors in the narrative (specially towards the end), the consequences of their actions, and the impactful climax would all help them understand the working of the system. In the next story, their interaction pattern would change based on what they would have learnt. They would make intentional and informed decisions and act according to one or more interaction styles - impacting Shiva's mood and the tone of the story, or controlling the story outcome, or matching the ambience to their prediction of the story. After understanding the system, a few readers switched from a passive to a more active role. Readers connected with the characters in the first half and supported the characters in the second half of the interaction. Given below are certain interaction patterns that were observed as the interaction progressed.

My favorite colors -> explore and understand the system -> ambience for me -> ambience for Shiva: This reader started by making Rangolis with his favorite colors, exploring the system, and then made ambiances for himself. He later created ambiances that best suited Shiva in a particular situation. He shifted from creating Rangolis for himself to creating Rangolis for Shiva. This shift was observed in many readers.

My favorite color -> support mood of story -> drive outcome: A few readers started with their favorite colors and shifted back and forth between multiple interaction styles of 'story supporter' and 'story controller'.

Explore and understand the system -> drive outcome -> create mood based on how I want the story's mood in that chapter to be: Here we observe how readers realized that they had less control over the story plot and shifted from 'story controllers' to 'meaning makers'

One reader enthusiastically changed the Rangoli rings and created different ambiances during the early stages of the interaction. Once he realized he could not control the plot but only the tone, he created an ambience that he liked and did not change that ambience for quite some time. In his case, the novelty effect wore off and he chose to create a comfortable listening space over creating an ambience that best suited the story.

Desire to experience the interaction again

Many people expressed the desire to experience the system again as they wished to understand the exact amount of control that they had over the system.

One of the readers interacted with both stories twice as he wanted to map out the system completely, understand the agency that he had, and act meaningfully according to the choices he was given. In his first round of interaction he understood the working of the system and realized the agency he had over the mood and tone of the story. In the second round, he felt as if he had transformed into Shiva and acted more meaningfully as he knew the plot of the stories. He also interpreted the endings differently each time based on the ambiances that he created even though he acknowledged that the content was the same

P05: "For Vayu's story the first time I made it a bit hopeful and happy so human race continued and all villagers recovered. He realizes his mistake and passes it on to anyone who is going that path. The second time was all angry. Shiva and Jhanvi were both really mad that they have given him so much and this is how he repays them. It's like a metaphor for the human race in general so in this second ending they all die."

5.4.2. Understanding the System

Readers connected the Rangoli colors with the ambiances and emotional tones through the narrative cues, the changes in the story tone, and the moods created by the ambience.

Ambiences

The contrast in the ambiances helped people map them to certain emotional settings. Furthermore, setting all three rings of the same color helped this process as extremity of the emotion in the environments was portrayed. The red (angry) and green (calm) ambiances were specifically contrasting and powerful. Some people connected with the feeling and sensation of the ambiances. People connected with different parts of the ambience (lights, sound, music, video). A few connected with the music as they termed yellow (happy) as 'upbeat' and red as 'fast paced'. Some people felt that the red lights were ominous. A few readers pointed out how the light effects would subtly change the colors of the Rangoli rings, making the lights a powerful part of the mood setting. Some people connected with the arousal of the ambience as they found green (calm) and blue (sad) to be low in energy and red (angry) to be fast paced. A few people believed that the red music would make the pace of the story faster. Some people noticed certain key words in the narrative that connected well with the ambience, which slightly changed their perception of the events.

P18: "Every time I put in red, I was like nope that was too much too fast, it was very sudden, I was surprised at how quickly things would turn south."

People who explored the demo version of the interaction longer had a better understanding of the system and were able to interact meaningfully quite early in the interaction. The demo version helped them feel the emotional settings and how they related to the colors. A longer demo could have also helped the people who felt overwhelmed by the system.

Rangolis and Narrative cues

As described previously, when the stories acknowledged the colors of the reader's Rangoli and specified the consequence of those colors, readers would connect the colors with the mood and tone of the story. The Rangoli cue towards the end was the

most attention grabbing and helped in mapping out the system. Drastic consequences in the narratives due to the Rangoli also helped to gain an understanding of the system. The more Shiva's behavior and tone changed in the narrative, the more people concentrated and understood the system.

P13: "I think that what clued me in first was the narrative, when she talked about red-blue and what it was and described the mood it was for Shiva; of turmoil, anger, joy, peace. That was a big clue in that helped me understand. Once I had that, I felt like I could piece it together myself."

P03: "(I understood) From the change of the narrative. The way you wrote, and respond was extreme enough that I could sense that difference. Initially I was more tranquil, so I could sense that difference even more. It was the extremity that clued me in. Aggressiveness leant itself to extremity."

Ambiences and Rangolis

Both the Rangoli and ambiances helped readers map out the system. Readers felt a connection between the colors and the moods due to the ambiances, and these mappings were confirmed when the narrative acknowledged the colors of the Rangoli and told readers of the consequences of those colors. Moreover, a match in the reader's expectations with the narrative tone led to more immersion and confirmation.

Existing knowledge on color theory mapping to moods helped a few readers map out the system early.

5.4.3. Mismatches, Misconceptions, Distractions

In this section I explain my findings on the mismatches causes and effect, misconceptions, and distractions.

Mismatches

At times, readers would create an ambience and a tone that would not match the story's content. Although each chapter was written to adapt to any ambience or tone created, a few chapters had essential plot elements that could not be represented in both happy and sad tones. Here is a chapter from 'the river' describing the same:

Negative valence: As the eras went by, the tale of the river lost its charm. People no longer believed in her magic. They became ignorant and stopped caring for the river. Jhanvi was no more a home to the thousands of creatures that lived within her. Many of the other rivers dried up because of the humans, but not Jhanvi, she was meant to go on forever. She was unhealthy, unhappy and her tainted aura trickled down to the humans as well. Humans started falling sick and their numbers decreased drastically.

Positive valence: As the eras went by, the tale of the river started to lose its charm. Many people no longer believed in her magic. They became ignorant and stopped to care for the river. Jhanvi was no more a home to the thousands of creatures that lived within her. Many of the other rivers dried up because of the humans, but not Jhanvi, she was meant to go on forever. While a few humans still believed in her powers and fought for her, Jhanvi remained unhealthy and her tainted aura trickled down to the humans as well. Humans started falling sick and their numbers decreased drastically.

In such chapters the tone of the story plot was sad, a very happy ambience would lead to an extreme mismatch in the tone of the narrative content and the ambience, resulting in a jarring experience and breaking the reader's immersion. Similarly, a mismatch was perceived when a negative valence ambience was created for a more positive tone chapter, yet this case was not as noticeable as the former.

Another mismatch observed was that not all ambient settings set the intended mood effect for all the readers. Although the ambient elements (lights, sound, music, video) did set the intended mood and tone for the majority of people, a few people would find icy images (linked to the sad ambience) calming, while others found it isolating. One reader found the thunder and rainstorm sound effects (angry sounds) soothing as he liked the sound of rain. Some readers found the sad ambient setting to be calming. However, these mismatches would be removed once the narrative would call out the colors of the reader's Rangoli and tell the reader of its consequence. This two-way affirmation through the ambience and the narrative helped people figure out the correct mapping between the story's tone, color, and ambience.

Impacts of Mismatches

Mismatches between the plot and the ambience as described above had both positive and negative impacts on the reader's experience. For some, it led to the inference that the story was pre-written, they had no control over the content, and/or major events of the story had an independent course. This inference could have resulted

in the 'story supporter' or 'meaning maker' interaction style, depending on the extent to which they believed this inference to be true. This helped them understand the agency they had over the narratives. The mismatches also brought more attention and focus as people questioned their understanding of the system. Readers acknowledged that the mismatched helped them learn how the system worked. It also helped them get rid of false assumptions they had, such as the experience may have branching narratives, or that each Rangoli configuration may be mapped to a different chapter. The mismatch in ambience and story plot broke immersion, which motivated people to act meaningfully as they held themselves responsible for this incongruity. This also encouraged them to change the Rangoli rings after every chapter, as they wished to create a meaningful experience.

At times, readers would change their interaction style because of these mismatches. They would become 'story supporters' from 'meaning makers' or 'story controllers' as they felt no agency in the experience. Some readers felt as passive listeners due to these incongruencies. For some readers, a mismatch in the expectation of the story ending would lead to disappointment rather than questioning their understanding.

P16: "At the beginning I thought I had direct influence over the next portion of the story, so I was changing a lot more frequently because I felt like I could direct the narrative. Once I realized that changing from happy to angry within one Rangoli didn't have a drastic effect, I changed it to sometimes what I felt the narrative would be and sometimes according to what the last narrative was."

However, I believe that the positive impacts of the mismatch in the ambience and the story plot outweighed the negative. Readers developed an understanding of the system, got rid of their false assumptions, and acted meaningfully because of the mismatches they encountered.

Distractions

There were a few things in the experience that led to distractions. At times, people would get distracted listening to the audio without any text or visuals for support.

A few readers were overwhelmed by the system as they were not able to listen, act, and understand the system all at the same time. This would affect their understanding of the story, they would not notice the diegetic nature of the Rangolis,

and/or they would not map the ambience to the mood. This half-baked understanding of the system may have led to the interaction style of 'story supporters' where people felt they had no agency over the story. At times, exploration would impact story coherence as well.

Readers found interleaving the stories (listening to both stories simultaneously) distracting as it broke their immersion. They would finish listening to one story first before moving on to the next story. they stopped interleaving the stories as soon as they understood the working of the system. A few readers tried to interleave to see how the stories impacted each other, or if the same ambience would have similar effects on the stories, or if the stories overlapped. However, most participants found this confusing or too abrupt.

A few readers were confused about how much impact they had over the stories. This was distracting as their goal was then to understand their impact on the narrative. Some readers wanted to know which chapter of the story they were listening to, so they could take meaningful decisions. The system did not give readers this knowledge.

At times the color of the Rangoli caused confusions. Each ring was made of a dominant and subversive colors. The yellow ring had a few shades of green and the green ring had a little yellow. The same held true for blue and red. This design decision was made so that the narrative could combine yellow and green as one entity (positive valence) and blue and red as the other (negative valence). The narrative would call out the dominant colors in the Rangoli rather than calling out each color of the assembled rings separately, which became a source of confusion. Readers had to be trained on how the system read the colors of the Rangoli during the demo version.

Misconceptions

Readers had a few misconceptions about the system which were generally cleared over time during the experience. A few readers felt that every possible ring combination would have a different narrative attached to it. This assumption overwhelmed the readers as people believed that the story may reveal in a non-linear way, or there might be a right or wrong way of interacting. This misconception was removed when the same combination of rings revealed different chapters linearly. However, a few readers tried to play back an old chapter by assembling the same rings.

Some readers believed that the ambiences they created would have a cumulative effect on the stories. They felt if they created many negative ambiences, the story would spiral down further. A few believed that the ending was based on the summation of all the ambiences they had created. A few readers feared a combinatory explosion as they believed that the narrative would branch out after every Rangoli. Mismatches between the ambience and the story plot removed this misconception.

Some readers believed that the colors were mapped to semantics such as blue to water, or red to fire. At times these mappings were a meaningful extension of the emotions such as creation for yellow and destruction for red.

One reader was under the misconception that the system was designed for a religious experience. This assumption was quickly removed as he interacted with the system.

5.4.4. Feedback

Participants believed that giving subtitles, reference to the current chapter and the option to repeat a certain chapter would have led to better understanding. Some readers felt that the rings were fragile and handled them delicately. One reader pointed out that the rings could be made rough or smooth, light or heavy, to metaphorically map the rings to the emotions (Macaranas et. al, 2012). Another reader felt that the centers they created for their own recordings could have been laser cut for uniformity. She also felt that grooves on the rings may have been better than using tapes as markers as sometimes the lighting made it difficult to find the tape. One reader pointed out how tangible rings could be manipulated in different ways such as stacking or rotating. Readers were expected to sit on the floor while creating Rangolis as the experience mimicked the traditional Indian style of Rangoli making. A few people found this arrangement uncomfortable.

Many readers acknowledged the exploratory freedom the system gave them. They wanted to bring their children to experience the system. A few termed the experience as 'artistic and creative'.

5.4.5. Summary of Learning and Interactions

Figure 5.3 summarizes the general learning curve that people experienced, as described in the previous sections. I observed how readers started by creating Rangolis based on their personal preferences, proceeded to understand the system, and then mostly half way through the experience (by end of story one), understood the system’s working and made informed decisions. Based on this understanding, they would choose an interaction style (story supporter, meaning maker, story controller), or change their interaction style or continue with their preferred style. Table 5.3 explains how readers developed an understanding of the system.

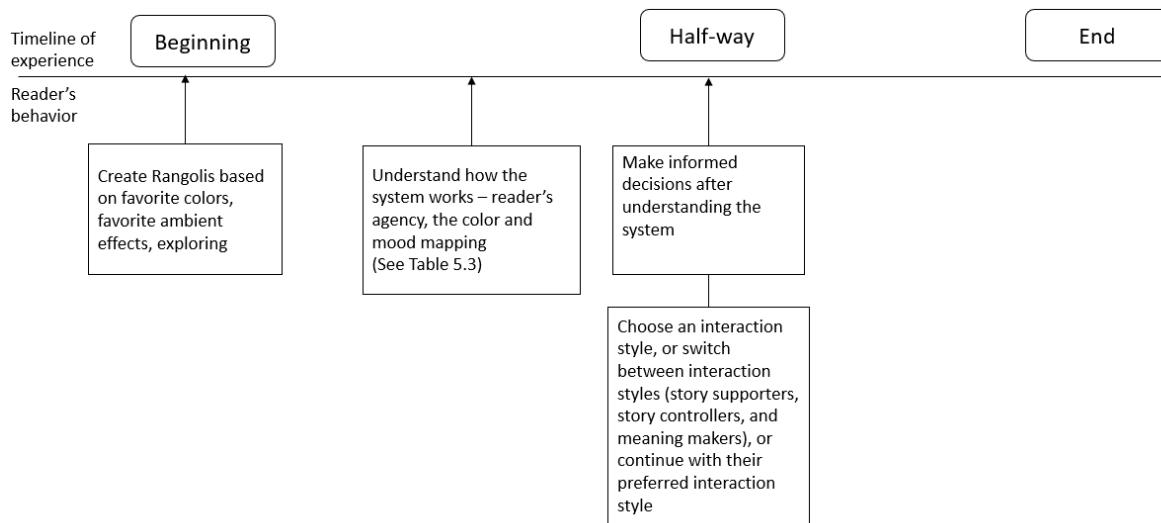


Figure 5.3 General learning curve

Table 5.3 Learning how the system works

What helped in learning	How it helped
Demo	Readers mapped colors to moods based on the ambient effects
Acknowledgement of the reader's Rangoli in the narrative	Readers understood the impacts of the colors on Shiva and on the story. They started to understand meanings of the colors
Impacts of the reader's created Rangoli in the narrative	Readers understood the impacts of the colors on Shiva and on the story
Contrast in Ambiences	Contrast in ambiances helped people differentiate between the moods
Narrative based changes	Contrasts in Shiva's mood and impacts on the narrative helped people understand the meaning of the colors
Warning readers of the impacts of their next Rangoli in the end of each story	Gained most attention, helped people confirm their understanding of the meaning behind each color
Mismatches in ambience and story plot	Readers realized the agency they had over the stories, got rid of false assumptions, some readers shifted between different interaction styles

5.5. Cultural Findings

In this section I elaborate on the findings that were related to the cultural aspect of this experience.

Cultural experience

People who were unfamiliar with the Indian culture liked that they were introduced to a new culture and that they were able to experience the system through a different cultural perspective. A few found the story content interesting as they had not heard of different Gods having opinions and negotiating with each other, or Gods talking to humans. These concepts were different from what they had heard in their own cultures. Readers also compared the Rangolis to their traditional concept of Mandalas and dream catchers. There were also a few elements in the experience that reminded them of their own culture which sometimes caused confusion. For example, the name 'Vayu' means ghost in Malay which disrupted one of the reader's story coherence. Few readers were apprehensive of cultural appropriation and mentioned that experiences should be mindful and respectful of the culture, which was achieved in this installation. Some readers had a difficult time remembering the Indian names used in the stories and hence lost narrative coherence.

People who were from an Indian background or were familiar with the culture found a sense of comfort in the experience. They were also more immersed in the stories as they had some previous knowledge in Indian mythology. One participant mentioned how the experience brought her back home.

Cultural Learning

Participants learnt about different cultural aspects from this experience. People from an Indian background mentioned how this experience added to their knowledge and reinforced concepts and morals learnt from Indian mythology. One reader used the moral of 'truth and righteousness' while crafting his own story ending. Readers felt that it gave them a new perspective of the Rangolis, the Gods, and for many it cleared the misconception of the negative connotation attached to the word destruction. One reader found the concept of extending mythological folk tales into fictional stories very interesting. Readers unfamiliar with the Indian culture were introduced to the way Indian mythology represents different Gods. They were also intrigued by the cyclic nature of creation, maintenance, and destruction. Many people internalized this concept as during their interview or during the recording of their story ending, they would extend the story of 'the river' by mentioning how in future Shiva would have to destroy things again as the cycle of creation, maintenance, and destruction would repeat.

Readers were curious to know more about Indian mythology, culture, and Rangolis after the experience. They perceived the installation as a fun and interactive way of learning about a new culture. After the interview, the readers were told that the stories were based on Indian mythology but were mostly works of fiction (Shiva creating Rangoli to express his mood and changing the state of the world is fictional). This caused a little disappointment in some participants as they wished that their learnings would hold true.

P17: "I was also intrigued by the story, as represented in other mythologies. Gods that bicker amongst themselves like humans, its very interesting. And to see many similar things, the power of the water, the Gods can grant gifts to humans, humans are flawed, misuse them and sometimes have to be taught in a pretty terrible way. The parallels but the uniqueness, I noticed all of that and was struck by it."

Higher Perspectives

People perceived different morals from the experience such as Earth being a gift and how people take this for granted, the perils of being greedy and importance of being righteous, and how actions taken with wrong intentions will ultimately lead to bad results. A few reader commented on the importance of emotions and role of aesthetics.

Many readers believed that destruction carried a negative connotation and creation carried a positive connotation. This led them to believe that Shiva may be evil, a misconception that was removed as the experience progressed. After the experience, they realized how destruction was a necessity at times and how creations with the purest intentions may not always be positive and may need to be destroyed. One reader mentioned how change was possible only through the cycle of creation, maintenance, and destruction.

After the experience, one reader commented how free will in life may be an illusion and we may just be the puppets of the Gods. One reader claimed that he became more aware of his own emotions and actions after the experience.

P05: "The whole ambience and setting and immersion gave me like (I was taking role of shiva) like even now I have this responsibility that I am taking to act according to what is good and righteous instead of my own lust or greed."

P02: "Shiva being the God of destruction, you see him as a villain always, but in this story, it gives me another view of Shiva, since he has a reason to destroy. His destruction is like a reset, a fix in some way."

P02: "Brahma and Vishnu, their titles make you think they are so good , they created us, they can't be bad. But they have their own conceit, which ties to ours as well, we feel anything that you create can't be bad. But it depends on what you do create. Not many people think about it, first I felt Shiva is the villain but as I went on I thought no."

System

People commented on how the stories had parallels with all cultures, yet some elements that were unique to Indian culture. The plot and conflict seemed universal to a few readers. The story, 'the river' was perceived as more culturally specific than the story 'the medicine'. One cultural assumption that was built into the system was that people would be comfortable sitting on the floor, mimicking the Indian tradition of making Rangolis on the floor. A few readers were uncomfortable or awkward about sitting on the

floor for an extended duration. All participants were given the option of sitting on a chair as well.

One reader pointed out how thematic Rangoli making was to the experience. Rangolis are created, maintained for a few days, and then cleaned out, which was similar to the story, 'the river's' theme of how everything is created, maintained, and destroyed. She mentioned the possibility of creating actual Rangolis during the experience and cleaning them out after their experience, reinforcing the learning of this cycle.

Cultural Values

People were asked about their understanding of the cultural values after the experience. They felt that Indian culture focused on symbolism, nature, spirituality, and community. They commented that Indian culture expressed emotions through art, and that art was an important part of mythology and traditions, as in the stories even Shiva performed a dance 'Tandava' to express his emotions. Some termed the culture as creative, colorful, vibrant, and 'beauty in chaos'. They saw the Rangolis as a representation of the cyclic nature of life. They felt that Rangolis were an expression of complex emotions and were also spiritual in nature as the art form connected people to the divine. Some participants described Rangolis as a meditative, contemplative and tool for focusing.

5.6. Creating Story Endings

In this section I describe the findings related to the part where participants created their own story endings by recording and making art on the center pieces.

Recording motivations

People were motivated to record their own story ending for several reasons. Some participants were interested because they wanted to change the ending of a particular story and give it a more hopeful and happy ending. Open ended stories gave more room for creativity and encouraged people to record as they wanted closure and answers to their lingering questions. Some also believed that their recordings may give closure to others as well. Some participants wanted to add more meaning to the story as they recorded the reason behind Shiva's destruction, gave morals to the stories, and

integrated their favorite ambiences with a meaningful ending. A few were motivated after they listened to what others had recorded, and a few did not want to feel left out by not participating. People were also driven by creativity as they wanted to make and leave behind an art piece of their own, engage in the art, challenge themselves, make the story their own, and engage with the system more. One reader compared the interaction with fan fiction as it gave the ability to personalize the story. Another reader recorded a happy ending emphasizing how it reflected his personality. Many participants embedded the cyclic concept of creation and destruction that they had learnt into their recordings.

Recording Holdbacks

Some people did not want to record as they were self-conscious of their voice, afraid that they would stutter, scared they would confuse the characters' names, worried about creating something on the fly, or couldn't think of anything unique to record. A few felt intimidated by what others had recorded. Some participants did not want to record as the stories were not clear to them, and a few did not participate as they felt they did not know anything about the mythology and culture.

Ambience and Art

For the art work on the center pieces, people recreated the symbols shown the rings and tried to symbolically represent their recording content. Some created art that represented their recording figuratively, while others used abstract concepts. One participant created sunny and stormy visuals on either half of his center piece to represent the two moods of Shiva. A few art works were inspired by the cultural concepts of symbolism.

The ambiences that were created while recording were a combination of personal favorites and a mood that supported the content of the recording. People used many colors while recording and labelled their ambience as a mix of many emotions. One participant used the water droplet sound to facilitate her recording of how the earth was cleansed one drop at a time.

Motivations for Listening

Participants were motivated to hear what others had recorded as they wanted to know about other's interpretations of the stories and their experiences. One reader expressed how they felt connected with others when they listened to the recordings.

Some wanted to gain more understanding of the system, the stories, and figure out if the stories had different outcomes. One reader mentioned how she wanted to get more out of the story world by listening to what others had recorded. People would select the centers to hear based on the appeal of the art. One of the participants drew a turtle on their center, which gained maximum attention. One reader mentioned that he forgot to listen to other recordings as he was very engrossed in making his own story ending. This listening process had a few unintended consequences as well. A few people compared their recordings with others and felt that other recordings were much better. Some participants would listen to the recordings before making their own and would feel that someone else had already recorded what they wished to record. Overall, this part of the experience was termed as fun and creative.

5.7. Summary

In this chapter, I first highlighted the ways people used and perceived ambiances. They felt as if they were a part of the story due to the environment created, they focussed more on the narrative, and the ambience helped them see different perspectives, derive various meanings, and bring about emotional responses. People interpreted ambiances to be continuous rather than discrete.

I also observed three interaction styles based on the level of agency perceived. story supporters –felt no agency over the story and interacted in ways to match the ambience to the narrative, story controllers –felt they controlled the story’s plot at key points, and meaning makers – who felt they had agency over the mood and tone of the characters and the narrative but not the story plot. These styles were not mutually exclusive as people switched between them throughout the interaction.

People also saw themselves take various roles in the narrative such as Shiva himself, a part of Shiva, or another character in the story. The acknowledgement of the Rangoli in the narrative helped people take responsibility of the story, connect with Shiva, and understand the mapping of the colors with the moods. It also helped some people take more active roles and feel more in control of the story. Both, the Rangoli in the foreground and the ambience in the background helped people connect with the story.

Readers developed a learning of the system and moved from exploration-based interactions to making informed decisions. The contrasts in the ambiances, long demos, changes in the narrative tone, acknowledgement of the Rangolis, and certain mismatches in ambience and story plot helped in learning how the system worked.

People enjoyed being a part of a culturally different experience. They derived cultural and deeper moral learnings from the narratives. They were motivated to record their own story endings because they wanted to close the open-ended stories and wanted to engage with the system more.

Chapter 6. Design Implications

In this section I give the implications for designing interactive storytelling experiences based on my findings. I first give implications for designing interactive ambient and emotional spaces. I elaborate on how to write narratives that give readers agency over the mood and tone of the story but not the content. Further I discuss how to design effective diegetic interfaces, support different types of interactions, and develop literacy of the system.

6.1. Ambience and Emotional Spaces

I speculate several design implications for interactive storytelling experiences that give readers the agency of setting the ambience to influence the tone and mood of the physical space and the narrative.

Ambiences representing Continuous Emotional Entities

I observed that readers used the ambience to give incremental and gradual changes in the mood and tone setting. In the experience readers believed that the effect of three red (angry) Rangoli rings on the ambience and the story would be worse than the effect of two red (angry rings) alongside one yellow (happy) or green (calm) ring. Hence in such experiences, the narrative and the ambient effects should be able to support varying intensities of a particular emotion. Certain elements of the ambience can support this perception, such as varying the music tempo and volume to differentiate between different arousal rates for the same emotion. In *Shiva's Rangoli* we used rings to represent unique and discrete emotions. Affordances such as turning of the rings or sliders can also help denote ambiances as continuous variables allowing them to represent varying degrees of emotions.

I observed that different colored rings (lights, sound, music) representing different emotions created a disruptive environment for some readers. For example, red flashing lights (red-angry ring), with water dripping sounds (blue – sad ring) with an upbeat music track (yellow – happy ring) may have created an incoherent environment. Designing systems that allow these different elements of lights, sound, and music to blend together well can help create more cohesive environments. In this experience we could have

modified the ambient effects after the Rangoli had been created, so different effects could blend well with each other and create a more cohesive environment. We could have also used the same music track for all four rings by varying the tempo and keys to represent different emotions. I propose that the ambient space should be able to represent a mix of complex and many emotions rather than mapping different emotions to individual components (lights, sound, and music) of the ambient space. However, it may be difficult to develop literacy around a system in which the ambiances represent varying intensities of a particular emotion or a blend of many emotions. It is important to help people develop an understanding of the extreme emotional representations of the ambiances before they explore the more complex ones.

Crafting the Ambience

I observed that readers liked crafting their own ambience by choosing different lights, music, and sound effects. Some readers found the lights to be the most powerful part of the experience, whereas others gravitated towards the sound effects and music tracks. Readers were also able to balance different goals of choosing their favorite effects while supporting the narrative as they had the ability to select each component (lights, sound, and music) of the ambience. Hence, giving people the ability to create their own environment by selecting and combining different components of the ambience, can be more beneficial than giving them the agency to select a pre-crafted environment where they have no agency over the individual components. It may also be beneficial to give readers the option of augmenting certain components (lights, sound, and music) to make them stand out more.

Ambience Impacting the Story

In *Shiva's Rangoli*, creating a particular ambience affected only one story segment as that choice did not impact any of the other story segments. I believe this was crucial, especially during the early stages of the interaction when people were still understanding the system's working. I also observed people changing their style of interaction after developing literacy, engaging with the system in different ways (story supporters, meaning makers, and story controllers). Hence, such interactive systems should not have cascading effects of choice over the entire experience as choices made in the beginning would attribute more towards exploration and understanding rather than meaningful intentions. People would not want to be held accountable for a particular

choice that they made in the beginning without having complete literacy of the system. Therefore, cascading effects of choices would be more appropriate for when the reader gains an understanding of the system and is able to make meaningful decisions.

Role of Ambiences in an Interactive Narrative

Ambiences and enclosed spaces (the tent in *Shiva's Rangoli*) can help create a focused space with less distractions. Ambient settings also help readers understand and concentrate more on the narrative compared to hearing narrative only through audio. They can set an emotional tone for the physical space as they can help create certain mood settings. This allows people to see different perspectives of the story, interpret the story as desired, enhance or diminish certain emotions in the narrative, and change the mood, tone, and pace of the story as desired. Ambiences can also help readers feel as if they are a part of the story world.

6.2. Writing the Narrative

In this section I discuss implications for writing a narrative in which the reader has the agency to change the mood and tone of the story, while keeping the underlying story intact.

Character

Readers felt that they had agency over Shiva's mood when they saw drastic changes in the way he responded according to the mood the reader had created. Hence, a character should express extreme intensities of various emotions through different dialogues (even if the dialogue carries the same meaning). These changes in dialogues can help readers feel that they have agency over the tone of the story. This adds to the design implication proposed by Tanenbaum and Tomizu (2007) where they suggest that different emotions can be attributed to different characters. I propose that aspects of the story that the readers have agency over (character mood in *Shiva's Rangoli*), should be represented in contrasting ways.

I also observed that people's perception of Shiva changed as they changed his mood and affective dialogue. Shiva could have been perceived as a God with a bad temper willing to exercise his power to set things right, or as a God trying to control his temper, yet still using his power to set things right. This form of agency can help readers

personalize their experience by experiencing different shades of the character. Nay and Zagal (2017) highlight how personalizing the character can help achieve meaningful interactions. Hence, representing a character's persona from different perspectives can be valuable. However, the character should have a pre-written personality rather than giving readers a blank slate. This will help readers empathize with the character and make the narrative coherent and meaningful. Furthermore, the character should stay true to their temperament throughout the narrative, even with the changing dialogues, as this will help create an impactful story. This implication is coherent with Tanenbaum's (2015) suggested design poetic for transformation through endowment.

I propose that it may be useful to write characters that are relatable to people, so they can connect with these characters. In our stories, Shiva was the God of destruction and had power above all, which may have hindered the development of an empathetic connection between the reader and Shiva.

It is also important to have the character's presence in nearly every segment of the story, especially if readers have agency over their mood. Hence, the character or object that the reader has agency over, should predominantly be a part of the story.

Different emotional tones of an event

Readers should be able to see the interactive narrative through different perspectives by changing the emotional tone, and hence, narratives should leave enough room for such interpretations. Open ended stories can help achieve this goal. However, each event of a narrative cannot be represented in various emotional tones. Hence, readers should be able to enhance or diminish certain emotions attached to a segment. Authors can write such pieces so that the underlying events can be represented in a better or worse way. For example, here are two versions of the same dialogue. These dialogues are a part of an intense scene where the Gods are concerned about the way the humans are mistreating a holy river.

Better: "The Gods once again paid a visit to the humans in their dreams and asked them to restore the river's purity, reminding them of the old golden days that once existed."

Worse: "The Gods once again paid a visit to the humans in their dreams and demanded them to restore the river's purity, warning them of the repercussions."

Both these dialogues express the same underlying emotion of concern for the river, however the 'better' version tones down the tension in the scene whereas the 'worse' dialogue adds to the tension. In such an intense scene, a happy ambience may lead to an incoherent experience, yet designers should not change the underlying story to avoid these mismatches. The positive consequences of mismatches between the ambience and the narrative content outweigh the negative consequences. These mismatches help bring the reader's attention, they help get rid of wrong assumptions such as branching path ways, and most importantly they help readers realize the amount of control they have over the narrative. This also aids them to understand how the system works, realize that they have agency over the mood and tone of the narrative but not the story content, and helps them develop an interaction style which is meaningful for them. If desired, designers can reduce these mismatches by hinting the readers of the upcoming events in the next segment. Furthermore, they can also include various elements that carry different emotional references in each story segment so that the ambience can amplify different aspects of the story. This can allow readers to support the narrative by creating meaningful ambiances.

Diegetic objects in the story

If diegetic interfaces (Rangoli and Ambience) are used to give readers some form of agency (emotional tone of story) in the story, it is important to acknowledge the reader's interactions with the interface in the narrative. This draws the reader's attention and helps them understand the working of the system. It is also important for these actions / interactions to have consequences in the story as narrative changes that are very subtle do not gain much attention. This implication has been explained in further detail in the sections below.

Feedback

In *Shiva's Rangoli*, readers expressed their wish to know how far along they are in the narrative. It is useful to provide this feedback as readers take decisions for their interactions accordingly.

Final Thoughts

I propose that it is worth writing the story first and then thinking about how the story can be represented in different emotional tones. Designers should find a balance

between the author's story content and supporting the reader's interaction, and designers should not change the author's story significantly to achieve this goal.

6.3. Diegetic Interfaces

In this section, I discuss design implications for creating diegetic interfaces and ways they can be inserted into the narrative. We used two diegetic objects – the Rangoli interface in the foreground and the Ambience in the background. Both these objects helped in setting an emotional tone for the narrative and the space. Some readers connected with the character's actions through the Rangoli interface, some readers connected emotionally with the characters through the ambiances, while a few readers connected to the story through both these objects. Diegetic objects in the foreground and background can collaboratively help in bridging the reader's world with the story world. Both these objects can support each other's functionality by establishing the same impact on the experience in different ways. I further elaborate on design implications for the diegetic Rangoli and ambience.

Diegetic Rangoli Interface

The Rangoli interface was diegetic as Shiva created the Rangolis that the reader created in the tent, establishing the existence of the Rangoli in both worlds. Readers felt they had agency over the character's actions and could see consequences of their choices play out because of the diegetic nature of the Rangoli interface. Hence, giving readers the choice to create different Rangolis through the interface proved to be a successful design element. Therefore, I believe that the diegetic interfaces should be dynamic rather than static, giving readers agency over the way they manipulate the interface. These interactions with the diegetic objects can then impact the narrative in different ways, providing readers some form of agency. This can allow them to take more active roles as they are endowed with responsibility. Mapping the readers actions with the diegetic interface (act of Rangoli making) into the story world can also help readers connect with the story. The acknowledgment of the Rangoli in the narrative helped readers understand the diegetic nature of the Rangolis and their role in the narrative. I propose that it is important to acknowledge the reader's interactions with the diegetic interface to help them understand how the interface connects with the story. These acknowledgements should take place multiple times in the narrative without being

subtle, to help readers internalize the concept. The diegetic interface can also play a central role in the story. Depending on the amount of agency the reader has, it would also be useful to connect the diegetic interface interactions with consequences. Please note that the term ‘consequences’ or ‘impacts’ do not refer to branching narratives. Here is an example demonstrating the same:

Positive valence: “Brahma and Vishnu approached Shiva and as they looked upon the vibrant Rangoli filled with shades of yellow and green, they were delighted to see that Shiva was in one of his good moods. The skies were light, harmonious and chirpy reflecting Shiva’s pleasure. Brahma and Vishnu never thought twice before approaching him on such days, and so they decided that it was the perfect time to confront him on one of their never-ending arguments, Shiva’s destruction.”

Negative valence: “Brahma and Vishnu approached Shiva, and as they looked upon the bold Rangoli filled with shades of blue and red, they understood that Shiva was not in the best of his moods. The skies were dark, gloomy, and enraged, reflecting Shiva’s displeasure. Brahma and Vishnu always thought twice before approaching him on such days, yet today they mustered the courage to confront him on one of their never-ending arguments, Shiva’s destruction.”

In this example, the consequence of creating the Rangoli a certain way impacts how Brahma and Vishnu approach Shiva. Even though the consequence is the same irrespective of the choice (no branching narratives), this particular segment drew the reader’s attention since their choice over Shiva’s mood had an impact over the way Brahma and Vishnu approached him. I conclude that such acknowledgements can help bring the reader’s attention and help them understand the meaning / impact of their choices with respect to the diegetic interface (which color maps to which emotion). The more impactful these consequences are, the stronger is the above-mentioned effect. If designers wish to give readers more agency over the story, readers should be warned about the dire consequences of their actions before their interaction. For example:

“Brahma and Vishnu looked down at the Rangoli, trying to assess Shiva’s temperament, and thus the fate of the river Jhanvi that lay in his hands.”

Here readers are warned that their / Shiva’s next Rangoli is going to determine the fate of the river. This warning was particularly powerful, and it was followed by the impactful climax which added to the importance of the created Rangoli. Hence, warning readers of impactful consequences (even if the consequence is always the same) can help them take more active roles. In *Shiva’s Rangoli*, a few readers claimed that they

transformed into Shiva at this very moment. This design implication supports the findings by Iten et. al (2018) who claim that people have a higher appreciation of the interaction when their choices have high meaningful impacts on the narrative. However, designers should be careful as this may lead to an illusion of control of the story plot which may not be the designer's intention. I also believe that the reader's every action does need to lead to a consequence as there should be room for people to interact with the story and understand the system's working without feeling constantly pressured and a false sense of agency. This supports the design poetic for agency suggested by Tanenbaum (2015) that distinguishes between investigation and progression.

The Rangoli interface gave readers a sense of responsibility as they impacted Shiva's emotions through the Rangolis. Furthermore, it was a shared object between the readers and Shiva. Hence, it is worth connecting the diegetic interface to an element that can give the reader some responsibility in the narrative, as it encourages them to act meaningfully. Giving readers a stake in the narrative and endowing them with responsibility can help them take ontological narrative positions (Harley et. al, 2016).

Diegetic Ambiences

Ambiences acted as diegetic interfaces as they set the aesthetics of the reader's physical space, as well as the story world's environment. Readers were able to place themselves in the story world and feel the character's emotions through the diegetic ambiances, allowing them to take internal positions in the narrative. Acknowledging the ambience in the narratives helped readers understand the diegetic nature of the ambient setting. Readers were able to sympathize with the characters as the ambiances helped them relate to the character's feelings. Hence, even though ambiances are in the background of the interaction, they can be connected meaningfully with certain elements of the narrative and act as diegetic interfaces. This can help transform the physical space of the reader to mimic the story's environment, bridging the gap between the real and story world. It is useful if the diegetic object in the background influences the story in a way that supports the impact of the actions taken through the foreground diegetic interface (Rangoli). For example:

“On such days, the harsh, dark, and stormy lands would fill the sky with a hint of red and blue, as they mimicked Shiva's Rangolis and his unpleasant mood.”

In this example, the ‘*the harsh, dark, and stormy*’ lands are mimicking the ambience created by the reader, giving the reader an agency over the environment of the story. Furthermore, it emphasizes Shiva’s unpleasant mood, reinforcing the choices (red and blue) set in the foreground (Rangoli) interface. I also observed the importance of giving agency of crafting the ambiances. In *Shiva’s Rangoli*, readers were able to enhance or diminish the emotions attached to a certain event through the ambiances, thus giving them agency of interpretation and perspective. This supports the earlier mentioned design implication of creating interactive diegetic interfaces and mapping these interactions into the story world.

Contrasts between ambient effects helped readers understand the connection between the ambiances and emotions. Hence, similar to how the narrative should have contrasting emotional dialogues, the physical space should also have contrasting ambient effects. Besides the light, sound, and music, the narrator’s voice and dialogue delivery can also help achieve the same.

It is also worth thinking of other ways in which the physical spaces can act as diegetic interfaces. Maybe certain locations can help traverse through a non-linear narrative. Designers can also think of other concepts that ambiances can be connected to besides emotions. Ambiances may map to different genres or different character perspectives, as they help people see the narrative from different viewpoints.

6.4. Supporting different types of interactions

In this section I describe the design implications to support different interaction patterns. In this study, I observed three interaction models: story supporters, story controllers, and meaning makers

Leave room to support different interaction styles

Each participant had a unique experience in the installation and had a different style of interaction. It is important to note that 20 out of the 21 participants found a meaningful way to interact with the system. This was possible only because the system gave enough room for participants to interact how they desired without forcing them to follow a particular interaction style (story supporter, story controller, meaning maker). Hence, such interactive narrative systems should not emphasize a right or wrong way of

interaction, as participants are already apprehensive of the same. People should not be penalized by the system for taking certain actions, by breaking story coherence, halting or disrupting the experience. Essentially, the show must go on. In *Shiva's Rangoli*, people felt more immersed through different actions, which helped them build their own style of interaction. They were self-motivated to support the story by taking meaningful actions, as any purposeful deviations would result in a break of immersion. The system did not put any external efforts to guide this interaction. This implication has also been suggested by Sengers & Gavers (2006) and by Tanenbaum et. al (2011) as they discuss the importance of openness in design for supporting multiple interpretations.

People were motivated to change the Rangoli rings after every chapter either to support the story's flow, or to interpret the story through different perspectives, or to influence the character's emotions and actions. This interaction of changing the Rangoli rings rather than using the same rings again, was desired but not purposefully enforced by the system. Hence, I conclude that people are self-motivated to act meaningfully, and the system should not penalize the participant to achieve the desired interactions.

Levels of agency

In *Shiva's Rangoli*, people felt they had different levels of control over the story. Story supporters felt they had no agency over the story and tried to support the events of the narrative. Meaning makers felt they have control over the mood, tone, and pace of the story. Story controllers felt they had agency over Shiva's actions at key points in the narrative. Based on these observations, I propose design implications that can give readers different levels of control over the narrative.

Story supporters tried to predict the next chapter of the story and match the ambience to their prediction. Their interactions could have been better supported by hinting them of the events that would take place in the next chapter. The strong personality of Shiva also helped guiding them, as readers would predict the character's action based on his temperament. For example, a few readers created blue and red Rangolis for Shiva as they felt it supported his title of God of destruction. Describing the scene of the narrative also aided these readers as they would try to re-create the environment of the story. Hence, in interactions where the level of control is low, the narrative should support readers and guide their interactions, which in turn will help readers to support the narrative. These findings were also observed by Tanenbaum et.

al (2011) in their evaluation of the Reading Glove, when readers picked up objects based on where the story was heading. They also suggested providing role playing support to the readers, so they could mirror the characters in the story.

Story controllers felt they had control over the story when their actions were called out in the narrative and when these actions had impactful consequences. Hence this interaction style can be supported by acknowledging the reader's actions, mapping actions to impact the story (even if the impact is the same irrespective of the choice), and warning readers of their actions. Giving readers a sense of responsibility in the narrative can also motivate them to think about their actions. Open ended stories also give enough room for different interpretations.

Meaning makers felt they had agency over Shiva's mood, tone, and pace of the story and the emotional context helped them see different perspectives of the story. Their interaction was supported by giving them the ability to represent certain events in a better or worse way, writing the stories in ways that could have multiple emotional tones, and giving them the freedom of setting the emotional context through the ambience. Therefore, interactive narrative experience should have enough room to accommodate different perspectives so that people can make their own meaning of the narrative through their actions.

I believe that agency over a narrative can be given in different ways to encourage meaningful actions, without giving control over the story content. Designers can think of other ways in which agency can be given to the readers in interactive storytelling. Character perspectives, non-linear narratives, different genres, and time lapses in a story are few suggested forms of agency.

6.5. Developing Literacy

It is essential for designers to support people in understanding how the system works for people to have meaningful interactions. I believe that impactful demos can help develop this literacy. The experience itself should be long enough to accommodate the learning curve that readers need to cross, and to diminish the novelty effect of the new experience. *Shiva's Rangoli* had two stories with 10 chapters each, which gave them enough time to map out the system's working.

It is helpful to give readers some context and essential knowledge before they start interacting. In *Shiva's Rangoli*, I observed the need to introduce people to Rangolis before they interacted with the system. It can also be useful to let the readers know the agency they have over the narrative before they start their experience, as this can reduce the time they take to develop literacy, hence allowing more meaningful interactions. A system that supports leaning will help readers not feel overwhelmed and aid them to better understand the system. Literacy development can also help readers take ontological positions rather than exploratory positions, hence enabling them to engage more meaningfully with the narrative.

Chapter 7. Answering Research Questions

In this section, I summarize my findings and design implications to answer my research questions. For the scope of this study, I concentrate more on answering RQ1 and RQ2. I also connect my work and findings with the literature.

RQ1: How do people interpret and interact with a narrative where they can craft the ambience of their space to impact the emotional and aesthetic context of the story, without changing the plot?

- What role does the ambience play in the system? How do people engage with and perceive these ambient effects?
- What are the interpretive and interactive possibilities of a narrative when the ambience / mood is changing? What agency do people perceive over the system and how do they act with this agency?
- How do people understand the working of the system? What is their interpretation of the system's working?
- How can we design interactive narratives that effectively give the reader agency over tone and mood of the story?

The ambience acted as a diegetic interface as it simultaneously existed in both the real and the fictional world, allowing readers to feel as if they were a part of the story world. It set an emotional tone that helped readers connect empathetically with the characters and guided them to see different perspectives. Some readers felt an emotional response because of the ambience. Ambiences also helped in immersion, especially when the story plot and the emotional tone of the space were in sync. The ambience helped in setting a solitary and focused space that aided the narrative comprehension. Readers were able to enhance or diminish certain feelings related to an event without changing the underlying emotion. People tried to represent complex emotions, different intensities of emotions, and a mix of many feelings through the ambiances. They connected differently with the different ambient effects (lights, sound, and music). Generally, one of the components (light, sound, music, and video) would stand out more and it would help in setting a particular mood.

I observed people developed different interactive styles – story supporters, meaning makers, and story controllers. These categories were not explicit as people had

overlapping interaction styles. Story supporters felt they had no impact over the story and thus created ambiences to support the next segment of the emotional context of the narrative based on their predictions. They felt immersed and successful when their ambiences matched the story's tone and held themselves responsible for any mismatch. Story controllers felt they had some agency over Shiva's actions and mood, especially when their Rangolis were acknowledged by the narrative and when their actions impacted the narrative. They also felt a sense of responsibility towards the characters and the stories. Meaning makers felt that they had agency over the tone of the story and mood of the characters, but not the plot. They changed the emotional tone of the story which allowed them to see different perspectives of the narrative. Ambiences helped them perceive a certain event in a better or worse way but did not change the underlying emotion related to an event. People felt that they could personalize the story and experience just by changing the mood and tone of the narrative.

People perceived different forms of agencies in these interaction styles. The common theme between their interactions was that all readers acted in meaningful ways and felt responsible for their actions. Moreover, the system reinforced meaningful actions by acknowledging the reader's Rangoli in the narrative, having consequences to reader's actions, warning readers of impactful consequences of their actions, giving readers responsibility of the characters, increasing immersion when the story plot and ambience matched, and allowing multiple interpretations by changing the story's tone to adapt to the ambience. This supports Tanenbaum and Tanenbaum's (2009) definition on agency as the process by which participants in an interaction commit to a meaning by taking actions and holding themselves responsible for the outcomes. They also suggest that systems should reinforce meaningful commitments.

Giving readers the ability to sculpt their own ambience by controlling every component (light, sound, and music) individually helped readers pursue multiple goals such as supporting the story and creating an environment that they personally liked. This supports one of Tanenbaum's (2015) design poetics for agency called Interpretive superposition which suggests how players can commit to multiple meanings, pursuing many objectives simultaneously.

These findings suggest that people can interact with stories in meaningful ways without having an impact over the plot. Moreover, people reflected on many aspects of

the stories such as the understanding of the cycle of life, destruction not having a negative connotation, and self-reflection of one's own actions and emotions. These reflections were possible because of the impactful stories, which may have lost their essence had people been able to control the plot.

People developed literacy of the system's working through the demo and as they progressed in their interaction with the narratives. Their interactions changed from exploration to informed decisions after understanding the system's working. Some people linked the emotional tone of the narratives with the ambiances to understand the mapping between the colors and the moods, while some people mapped the system through the acknowledgement of their Rangoli in the narrative. Impactful consequences (that did not change the story's plot) to people's actions helped in gaining more attention and reinforcing their understanding. The contrasting effects of the ambiances also aided this mapping. Mismatches in the ambience and the plot in certain segments helped people realize how the system worked and helped them understand the agency they had over the system. Hence, some people also changed their interaction style after these mismatches. This also encouraged them to change the Rangoli rings after every chapter as they wished to create meaningful experiences.

In the design implications section, I have elaborated how designers can create interactive narratives to support agency over the mood and tone of the story without changing the content. I propose that the emotional dialogues delivered by a character should be contrasting, the narrative should leave room for different emotional interpretations by representing events in better or worse ways, the characters should be relatable, and the reader's actions should be called out. I discuss the importance of designing systems that leave room for different interaction styles and allow people to engage with the system in different ways, without penalizing them for taking undesirable actions. I give design implications for supporting different types of interaction styles / levels of agency as described above. I also discuss the importance of supporting readers to develop literacy for the system. I conclude by suggesting that designers should think of different forms of agencies that do not compromise the story's content to provide readers with an interactive experience. These implications support Tanenbaum's (2015) suggestion of providing players agency by making meaningful performative choices that impact the mood without undermining authorial style and message.

RQ2: How do people engage with diegetic interfaces in an interactive narrative?

- How do diegetic interfaces connect readers with the story world?
- How can we design diegetic interfaces that can support this connection?
- What roles do people adopt while interacting with the narrative?

The Rangoli interface and the ambiances both acted as diegetic objects. The Rangoli interface was in the foreground of the interaction and helped readers take certain actions in the story whereas the ambience was in the background and helped people feel the emotional tone of the story. Both these objects supported each other's functionality by establishing the same impact on the experience in different ways. Acknowledging the reader's Rangoli in the narrative and linking their actions to consequences (even though the consequences were the same irrespective of the choice) helped them focus, take certain actions, and understand the connection of the interface with the narrative. The ambient settings helped people feel how the characters felt and readers could see the characters reflect the moods they had created. The ambiances also transformed the reader's physical space and made them feel as if they were a part of the story world. People felt a sense of responsibility for the characters as the diegetic objects impacted Shiva's mood. This even helped a few readers transform into Shiva.

Readers took different roles during their interaction. A few transformed into Shiva, a few felt connected with him or as a part of him, some felt like a different character or observer in the story world, and a few felt they were passive listeners. The diegetic nature of the Rangoli and ambiances helped readers feel as if they were a part of the story.

Referring to Harley et. al (2016), I observed that readers took different narrative positions and shifted between these positions during their interaction. Some people took internal positions as they saw themselves as a part of the narrative, where as some readers too external positions. I observed both exploratory and ontological interactions. Readers took exploratory positions during the early stages of the interaction when they were understanding the system's working. After crossing the learning curve, they took ontological positions as they could impact the character's mood and story's tone through

their actions. The narrative choice also shifted from implicit to explicit once readers knew how to interact with the ambiances to change the emotional tone of the story and understood that their choice would only affect the character's mood and story tone but not the content. Story controllers and meaning makers took an ontological position, whereas story supporters took a more exploratory position. Similar to Harley's et. al's finding, I observed that people who took an ontological position felt responsible for the characters, acted meaningfully, and at times transformed into Shiva. Since I observed people shifting between multiple narrative positions, I propose extending the tangible interactive storytelling framework to consider the learning curve (temporality) and the different types of interaction styles (interpretation) that a system can support as people interpret the system in different ways. The authors discuss the need for more explicit, ontological, and internal narrative systems. I believe that *Shiva's Rangoli* was able to support these narrative positions and choices.

Tanenbaum (2015) explains transformation as putting one's own identity to a pause and experiencing the world from a new point of view. I observed a few readers transformed into Shiva and some readers reported a sense of stepping inside the story world due to the ambient effects. Hence, I interpret this to suggest that transforming physical spaces alongside transforming individuals can have empowering effects.

In the design implication section, I discuss how diegetic interfaces can be designed to support the reader's connection with the story world. I elaborate that both foreground and background diegetic objects can be connected with the narrative. Background objects (ambiances) can impact the story in ways that support the choices made through the foreground interface (Rangoli). Interactions related to the diegetic object should be acknowledged multiple times in the stories to develop an understanding of how the diegetic interface connects with the story. Impactful consequences of interactions with the diegetic interface (even if consequences are the same irrespective of choice) can give a sense of control and accountability over the story. I also discuss the importance of making the diegetic interface interactive to give readers different forms of agency through the interface. Pavia (2005) discusses that readers should play active roles and be able to influence the way the narrative progresses. Diegetic objects that can be manipulated by the reader to impact the narrative in different ways can support Pavia's theory. I further suggest that diegetic objects should impact the story in a way that gives readers a responsibility in the narrative. This design implication supports the

findings by Iten et. al (2017) who claim that people are motivated to act meaningfully while making ‘social’ choices, that is when their choices impact other characters.

Figure 7.1 summarizes answers to RQ1 and RQ2.

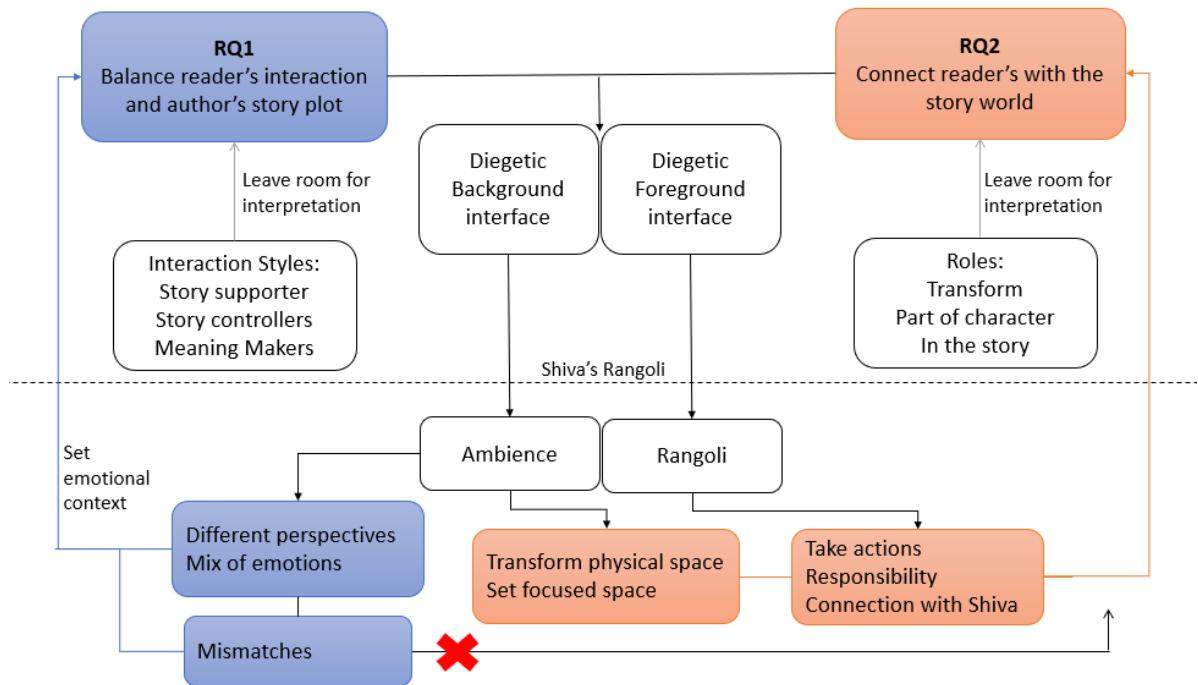


Figure 7.1 Summary for RQ1 and RQ2

My aim was to find a balance between the reader's interaction and the author's story plot, by giving readers agency over the emotional context of the story, but not the plot. I also aimed to find ways to connect readers with the story world through diegetic interfaces. To achieve these goals, I created background (ambience) and foreground (Rangoli) diegetic interfaces. The interactive ambience helped people see different perspectives, derive different meanings, and represent complex emotions. This helped readers set an emotional context to the story, helping me achieve the goals for RQ1. The ambience helped set a focused space and made people feel as if they were a part of the story, helping them connect with the story. The interactive Rangoli made readers relate with Shiva, helped them take actions in the narrative, and made them feel responsible, through which they connected with the story world. Mismatches helped people realize their agency over the story, even though it hindered their connection with the story world.

From this study I saw three interaction styles which may be used as a framework to identify and design different forms of agency in interactive storytelling. People positioned themselves inside the story and connected in different ways. I hope These roles can be used for further research. Lastly, I feel both goals were achieved because there was enough room for various open interpretations.

RQ3: How do people perceive an interactive storytelling experience through a non-western cultural lens?

- What are their understandings and takeaways of the culture after the experience?
- Does the system spark more curiosity about the culture?
- How do they feel about being part of a new culture? How do people from the same culture experience the system?

People from an Indian background expressed how this experience added to their learning and reinforced the morals of Indian mythology. Readers unfamiliar with the Indian culture were introduced to Indian mythology and they were intrigued by the cyclic nature of creation, maintenance, and destruction. They expressed their views on the culture as vibrant, colorful, spiritual, and artful. Readers were curious to know more about Indian mythology, traditions, and Rangolis after the experience. They perceived the installation as a fun and interactive way of learning about a new culture. They derived higher moral meanings from the narratives as well. People who were unfamiliar with Indian traditions and mythology liked hearing the narrative from a different perspective. Some elements such as the names in the narrative caused confusions. People who were from an Indian background or were familiar with the culture found a sense of comfort in the experience and were more immersed in the narratives due to their existing knowledge.

RQ4: Do people engage creatively with the story authoring platform? What motivates them to create?

People created their own story endings for a variety of reasons. Some wished to close the open-ended story and find closure. Open ended stories also gave space for more creativity. Some people wanted to add more meaning to the story. They wanted to channel their creativity by recording and making their own art piece. Many people

listened to what others had recorded to know how others experienced the system, to gain more understanding of the system and the stories, and to experience something more of the story world. People termed this part of the experience as fun and creative.

Chapter 8. Conclusion and Future Work

My aim for this thesis was to study how people interact with a storytelling system by engaging with a story at the level of its emotional and aesthetic context, through tangible and diegetic interfaces. I briefly studied how people experience such interactive installations through an Indian cultural lens. I also briefly investigated what motivates people to engage in creative activities such as making Rangoli based art and authoring extensions to the story.

To pursue these research interests, we created *Shiva's Rangoli* an interactive storytelling installation based on Indian mythology and culture. *Shiva's Rangoli* uses a diegetic interface that is present in the reader's world as well as the fictional world. The interface mimics an Indian art form called Rangoli making. Readers use this interface to sculpt the ambience of their physical space, setting a mood and tone to the story as well as to their own space. In this way, readers engage with the narrative at its emotional context without changing the narrative's plot. Hence, readers do not decide 'what' actions characters take, rather they decide 'how' characters feel and 'how' they perform the action (Tanenbaum, 2015).

My findings suggest that ambiances can help transform the physical space to connect the reader to the fictional world. They can act as 'diegetic' interfaces, existing in and impacting both the story and the reader's world. I also found that people aim to represent complex emotions through ambient settings. I observed how people perceived different levels of agency based on their understanding of the system. They developed different interaction styles - story supporters, meaning makers, and story controllers to engage with the stories in diverse yet meaningful ways.

Based on my findings I propose design implications for interactive narratives that give agency over the emotional tone of the story. I suggest how background interfaces such as ambiances and foreground interfaces such as the Rangoli, can both act as diegetic objects and work collaboratively to connect the reader to the fictional world. I further discuss how such interactive systems should leave room for interpretation and should be able to support multiple forms of interaction.

For the scope of my master's thesis, I concentrated my study more on ambiances, interaction styles, and diegetic interfaces. In future studies I will elaborate my findings on the cultural aspect of the experience, the story authoring experience towards the end, and ways in which such installations can encourage people to engage in story telling / authoring creatively. I would also like to conduct a quantitative analysis of the data to further analyze the cause and effects of the interaction styles (story controllers, meaning makers, and story supporters), the most preferred interaction style and why, how effective the ambiances were in creating certain mood effects, whether spending more time in the system had impacts on the interaction style, to what extent the demo helped in building literacy, and whether the cultural background of the person impacted their experience.

I also observed that people were hesitant to interleave the stories and preferred to listen to one story at a time. However, I believe there may be interesting interactive possibilities in interleaving different stories. In this experience, interleaving could have been made a desirable action by having cascading effects of the ambiance over both stories. For example, one particular ambiance would have an impact on story 1 which would lead to certain events in story 2. Hence, I would like to explore how people interact with a narrative experience where more than one stories are tied together and can impact each other.

I wish to investigate designs that can help readers transform into a character. I speculate whether longer narratives would help in committing people to the narrative further (Harley et. al, 2016). I would also like to extend this design to accommodate multiple readers, an affordance of tangible interfaces that the current design does not take advantage of (Fernaesus et. al, 2008).

Based on my design implications, I will represent the ambiances as continuous entities rather than discrete ones. It would also be interesting to give different weights to the ambient components (lights, music, sound) while setting an emotional tone, based on the reader's preference of the component they find most powerful.

I would like to mention interesting use cases of this system that participants suggested. Many people mentioned the possibility of taking the system into a performative space such as live plays and dance performances. A trained musician

mentioned how people are unable to understand Carnatic (Indian) classical music because of their lack of knowledge in ragas (melodies that represent emotional tones). She felt this system could help people appreciate Carnatic music as they would relate to the emotions expressed by the ragas. Many people expressed the utility of the system in children's education. Some interesting ideas were to use the system to help children regulate their emotions, help them understand the control they have over the rest of the world, and give them therapeutic, meditative, and multi-sensory experiences. A few people mentioned that this was an engaging way to learn about a new culture and could be further extended to highlight the diversity within Indian culture. In particular, I would like to investigate on how this piece can be extended for augmenting performative spaces. I also wish to design and create a smaller and portable version of *Shiva's Rangoli* that can be deployed at homes for personal experiences.

I aim to speculate further on the different forms of agency that interactive narratives can provide without giving control over the story plot. I wish to further investigate the role and design implications of diegetic interfaces in interactive narratives as well. I am also interested in studying how interactive ambient settings can be used in broader contexts such as public spaces, homes, and educational settings.

I hope this study can help designers create interactive narratives that can meaningfully engage readers, deliver impactful narratives, and help bring the reader closer to the fictional world.

My personal takeaway from this study was that it taught me a life lesson. In *Shiva's Rangoli*, we only have control over the way the characters feel and not the actual plot. Similarly, in the story of our lives where we are the characters, we may not have complete control over every event. We can only choose how we perceive and react in certain events and situations. In tough times, we can either sulk or find a silver lining. In happier moments, we can choose to celebrate or worry about something else. Either way, the plot of our life will not change, but our attitude towards life can definitely change our experiences.

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Appendix A. The River

Positive Affect Version

In an era of early civilization, marked as the Golden age of truth and enlightenment, the Gods looked upon from up above marveling at their creation and the harmony within. The 3 Gods Shiva, Vishnu and Brahma were in a deep heated discussion. Brahma was known for his creations. The humans, the earth, and every tiny spec of life owed their existence to him. Vishnu was the maintainer, the delicate balance that made life possible was his responsibility. The almighty Shiva was known for his destruction. He destroyed what was no longer meant to be, giving space to new creation.

Shiva was in the midst of making the perfect Rangoli, a beautiful symmetric pattern on the floor of his abode. Shiva often practiced this art form to express himself, as his Rangolis reflected how he felt. The Rangolis would shape the ambience of the heavens and everywhere on earth, mirroring his state of mind. Brahma and Vishnu approached Shiva and as they looked upon the vibrant Rangoli filled with shades of yellow and green, they were delighted to see that Shiva was in one of his good moods. The skies were light, harmonious and chirpy reflecting Shiva's pleasure. Brahma and Vishnu never thought twice before approaching him on such days, and so they decided that it was the perfect time to confront him on one of their never-ending arguments, Shiva's destruction.

"Do you remember the beautiful ice age that once existed?" asked Brahma. "You just had to melt that down didn't you, Shiva?" Shiva's rangoli was turning into shades of yellow and green as he maintained his calm during the argument. He pacified Brahma, "The ice age had gone too far, and no living thing was able to survive in those conditions. It is that melt down that helped you create those humans." Vishnu too joined in the argument, "And what about the era of the dinosaurs, that meteor was just out of rage Shiva! Do you know how hard I worked to maintain balance in that environment?" Shiva laughed, "Oh that was one of your most boring works, all those dinosaurs did was eat each other, there was absolutely no spice to it." Brahma and Vishnu decided to take advantage of Shiva's unusually cheerful mood and ambushed him by expressing their unhappiness as he destroyed everything they created and maintained. After a long

discussion, Shiva finally gave in and promised them this. “Fine! One creation and that is it. This creation will exist till you both do. It will die when time itself ceases. I shall not touch this creation of yours.”

Vishnu and Brahma were delighted and after giving it a thought they went to Shiva with the proposal of the river Jhanvi. “I would like to create an eternal river” said Brahma. “This river would be the heart and soul of all the living” added Vishnu. “And to maintain the purity of Jhanvi we wish to give her special powers. She will be capable of granting people what they wish for but only if their intentions are of utmost purity, if not, Jhanvi has the freedom of teaching them a lesson in her own way.” Shiva warned them “I hope you both know what you are doing, eras will come and go but Jhanvi will be a part of every time that comes into existence.” Brahma and Vishnu nodded in joy. Shiva took a drop of his sweat and released it down onto the mighty Himalayan mountain range. The mountains parted, giving way to Shiva’s droplet as it transformed into the holy river.

The Gods visited the human in their dreams to tell them about the new river, and her mystical powers. The humans worshipped the river and took good care of her. They witnessed her magic, as she granted peace and prosperity to those with a pure conscience and righteously punished those who came to her with dark desires. The lands flourished and Jhanvi fulfilled her duty for years and years.

As the eras went by, the tale of the river started to lose its charm. Many people no longer believed in her magic. They became ignorant and stopped to care for the river. Jhanvi was no more a home to the thousands of creatures that lived within her. Many of the other rivers dried up because of the humans, but not Jhanvi, she was meant to go on forever. While a few humans still believed in her powers and fought for her, Jhanvi remained unhealthy and her tainted aura trickled down to the humans as well. Humans started falling sick and their numbers decreased drastically.

From up above Shiva, Vishnu and Brahma observed with deep concern. Vishnu said, “I was unable to maintain her purity. I will fix Jhanvi.” Shiva was feeling oddly calm that day and his serenity was echoed by the rare sunny and gentle lands. He looked at Vishnu and pacified him, “This is not your fault Vishnu, this era has witnessed humans in their most unpleasant form. They are responsible for her and they shall fix her”. The

Gods once again paid a visit to the humans in their dreams and asked them to restore the river's purity. From the very next day, humans started cleaning out Jhanvi and tried their best to restore her. However, the majority of the race was still ignorant, and the process of the cleansing was a slow and painful one. The river occasionally bestowed her magic on the ones that tried to save her, yet she continued to punish the ones that polluted her.

Vishnu and Brahma were extremely concerned. "Shiva, the river will kill the humans, we can no longer control her. She must be stopped" said Vishnu. As Vishnu and Brahma continued to pester Shiva, Shiva sat down and started creating a rangoli, a form of art he practiced to clear his mind. Brahma and Vishnu looked down at the rangoli, trying to assess Shiva's temperament, and thus the fate of the river Jhanvi that lay in his hands.

Vishnu and Brahma felt a ray of hope as they saw the Rangoli made with sparkling patterns of yellow and green. The skies turned peaceful and joyful as Shiva's tranquility flooded into the human world. Shiva exclaimed, "Because of my vow, I cannot take away the river, but I can try to purify her, however, the repercussions of her cleansing are beyond my control". As Shiva spoke he began to purify Jhanvi, and rains trickled down on earth. It rained for days, weeks and then months. As the river's purity was restored from the new rains, the humans struggled to survive the harsh new lands that were born, and their numbers started to decrease. On the 108th day of the rain, when the last few humans stood on earth, Jhanvi rose to massive heights. She whispered to the humans, "I once gave you peace and prosperity, but you made me incapable of nurturing you any further. The Gods have granted me a new life. I will continue to fulfill my duty, I hope this time you fulfill yours". As the river's words vanished, the last of the surviving humans ran frantically, hoping to seek any source of shelter left untouched by the river's cleansing. The next day, the rains stopped, and Jhanvi sparkled under the sun, in all her glory.

"Shiva! The cleansing gave Jhanvi a new life, but I am yet to find any humans that survived." exclaimed Brahma. Shiva replied calmly, "You made me promise that I could not destroy Jhanvi, this was the only way to end the madness. The humans' havoc had not only touched Jhanvi but nearly everything you created. I give you a blank

canvas once again Brahma, now create creatures that are worthy of the river and whatever else we have to offer.”

Negative Affect Version

In an era of early civilization, marked as the Golden age of truth and enlightenment, the Gods looked upon from up above marveling at their creation and the harmony within. The 3 Gods Shiva, Vishnu and Brahma were in a deep heated discussion. Brahma was known for his creations. The humans, the earth, and every tiny spec of life owed their existence to him. Vishnu, was the maintainer, the delicate balance that made life possible was his responsibility. The almighty Shiva, was known for his destruction. He destroyed what was no longer meant to be, giving space to new creation.

Shiva was in the midst of making the perfect Rangoli, a beautiful symmetric pattern on the floor of his abode. Shiva often practiced this art form to express himself, as his Rangolis reflected how he felt. The Rangolis would shape the ambience of the heavens and everywhere on earth, mirroring his state of mind. Brahma and Vishnu approached Shiva, and as they looked upon the bold Rangoli filled with shades of blue and red, they understood that Shiva was not in the best of his moods. The skies were dark, gloomy, and enraged, reflecting Shiva’s displeasure. Brahma and Vishnu always thought twice before approaching him on such days, yet today they mustered the courage to confront him on one of their never-ending arguments, Shiva’s destruction.

“Do you remember the beautiful ice age that once existed?” asked Brahma. “You just had to melt that down didn’t you, Shiva?” Shiva’s Rangoli was turning into shades of blue and red as he was getting annoyed and angry with Vishnu and Brahma. He snapped back, “The ice age had gone too far, and no living thing was able to survive in those conditions. It is that melt down that helped you create those humans.” Vishnu too joined in the argument, “And what about the era of the dinosaurs, that meteor was just out of rage Shiva! Do you know how hard I worked to maintain balance in that environment?” Shiva dismissed his remark saying, “Oh that was one of your most boring works, all those dinosaurs did was eat each other, there was absolutely no spice to it.” Brahma and Vishnu ambushed Shiva by expressing their unhappiness with him as he destroyed everything they created and maintained. After a long discussion, Shiva finally

gave in and promised them this. "Fine! One creation and that is it. This creation will exist till you both do. It will die when time itself ceases. I shall not touch this creation of yours."

Vishnu and Brahma were delighted with their victory and after giving it a thought they went to Shiva with the proposal of the river Jhanvi. "I would like to create an eternal river" said Brahma. "This river would be the heart and soul of all the living" added Vishnu. "And to maintain the purity of Jhanvi we wish to give her special powers. She will be capable of granting people what they wish for but only if their intentions are of utmost purity, if not, Jhanvi has the freedom of teaching them a lesson in her own way." Shiva warned them "I hope you both know what you are doing, eras will come and go but Jhanvi will be a part of every time that comes into existence." Brahma and Vishnu nodded in joy. Shiva took a bead of his sweat and released it down onto the mighty Himalayan mountain range. The mountains parted, giving way to Shiva's droplet as it transformed into the holy river.

The Gods visited the humans in their dreams to tell them about the new river, and her mystical powers. The humans worshipped the river yet feared her rage. They witnessed her magic as well as her darkness, as she granted peace and prosperity to those with a pure conscience and her wrath was unleashed on those who came to her with impure desires. The lands flourished and Jhanvi fulfilled her duty for years and years.

As the eras went by, the tale of the river lost its charm. People no longer believed in her magic. They became ignorant and stopped caring for the river. Jhanvi was no more a home to the thousands of creatures that lived within her. Many of the other rivers dried up because of the humans, but not Jhanvi, she was meant to go on forever. She was unhealthy, unhappy and her tainted aura trickled down to the humans as well. Humans started falling sick and their numbers decreased drastically.

From up above Shiva, Vishnu and Brahma observed with deep concern. Vishnu said, "I was unable to maintain her purity. I will fix Jhanvi." Shiva was feeling upset that day, and his annoyance was echoed by the dingy and sad lands. He frowned at Vishnu and patronized him, "You are not the only one to blame, Vishnu. This era has witnessed humans in their ugliest form. They are responsible for her and they shall fix her. "The

Gods once again paid a visit to the humans in their dreams and demanded them to restore the river's purity, warning them of the repercussions. From the very next day, humans started cleaning out Jhanvi, trying to restore her in fear of the consequences. However, the majority of the race was still ignorant, and the process of the cleansing was a slow and painful one. The river continued to punish the ones polluting her, raising a havoc of illness on them.

Vishnu and Brahma were extremely anxious. "Shiva, the river will kill the humans, we can no longer control her. She must be stopped" said Vishnu. As Vishnu and Brahma continued to pester Shiva, Shiva sat down and started creating a Rangoli, a form of art he practiced to clear his mind. Brahma and Vishnu looked down at the Rangoli, trying to assess Shiva's temperament, and thus the fate of the river Jhanvi that lay in his hands.

Vishnu and Brahma were terrified as they saw the Rangoli made with daring patterns of red and blue. The skies turned bloody and mournful as Shiva's rage flooded into the human world. Shiva exclaimed, "The humans have brought this upon themselves. Because of my vow, I cannot take away the river, but I can give her a new home where she will once again be pure and looked after." Shiva broke into his unstoppable dance 'Tandava' and the lands flooded with rains. It rained for days, weeks and then months. As the river's purity was restored from the new rains, the humans grew lesser in number. On the 108th day of the rain, when nearly the entire human race was wiped out, Jhanvi rose to monstrous heights. With all her power and rage she roared to the humans, "I once gave you peace and prosperity and you payed me back by defiling me. Do you not realize, that my water is feeding you? I am the very reason you survive. But you have defiled me enough, and it is time this stops." As the river's words vanished, the last of the surviving human race came to an end. The next day, the rains stopped, and Jhanvi sparkled under the sun, in all her glory.

"Shiva! You destroyed the human race!" exclaimed Brahma. "They were my most intelligent creation." Shiva replied calmly, "Had they been that intelligent they would have taken care of the holy river. You made me promise that I could not destroy Jhanvi, this was the only way to end the madness. The human's havoc had not only touched her but nearly everything you created. I give you a blank canvas once again Brahma, now create creatures that are worthy of the river and whatever else we have to offer."

Appendix B. The Medicine

Positive Affect Version

Vayu and Rekha were a happy and pious couple that lived in a village just off the banks of river Jahnvi. They worked as farmers and their wages were just about enough for them to live a comfortable life. Soon they were blessed with a baby girl, who they called Nandini. Nandini was the heart and soul of her parents. The years went by, and the small family took care of the farms and made their living.

Vayu was a sincere devotee of God Shiva. He firmly believed in the scriptures that perceived the world as an image of Shiva's aura as they believed that the Earth's skies would shape themselves to reflect Shiva's emotions. They also stated that Shiva's Rangolis were a holy form of art as he often expressed his feelings through these Rangolis. Vayu's devotion towards Shiva was remarkable. On happy and harmonious days like today, Vayu's prayers would always be answered. On such days, the blissful lands would fill the sky with a tinge of yellow and green, as they mimicked Shiva's Rangoli and his cheerful mood.

Money was a never problem with just Vayu and Rekha, but as Nandini grew up, Vayu wished to provide her with all that she wanted and more. One night, Nandini started shivering, and she woke her parents up complaining. "Mother, I feel very cold and my body hurts." Vayu rushed her to the village hospital where the doctors looked after her overnight. As dawn broke, Nandini's condition worsened. The doctors tried to diagnose her all night but were unsuccessful. Heart-broken yet hopeful, Vayu took Nandini back home.

With all his determination, Vayu prayed to God Shiva for help. Shiva was at his abode, gazing at the lively yellow and green Rangoli he had just created. The Heavens and the lands were bright, jovial, and peaceful as they symbolized Shiva's state of mind. Shiva immediately went to visit Vayu in his dreams and whispered "My child, I have heard your prayers. Go to river Jhanvi and ask her what you want. She will grant your wishes if your intentions are pure." Jhanvi was born from the essence of God Shiva. Hence her personality, temperament, and powers were all an embodiment of the mighty God himself.

Vayu abruptly woke up and ran to the river in the dead of the night. He bowed down and prayed to her for Nandini's health. The calm and shimmering river came to life and softly whispered, "Vayu, you have a clear heart and a pure conscience, take my water and tomorrow, let the first ray of light hit the water you have taken. The water will turn golden, ask your daughter to take a sip of this and her health will be restored." Vayu carried her water in his flask and followed river Jhanvi's instructions. At dawn, Nandini took a sip of the holy water and the color on her face immediately returned. She gained her health back in no time. Vayu and Rekha felt relieved and thanked the Gods and the river for their grace.

After a few days, Vayu headed out to the vibrant village market. "Vayu, how is Nandini now?" asked a familiar voice. Vayu turned to find his friend Vijay calling out. Vayu told Vijay that Nandini was doing well and that he had finally found a medicine that worked. He hid the details of his encounter with the river. "That is good news, Vayu. This disease seems to be spreading in the village". said Vijay. Vayu exclaimed, "that is terrible, have the doctors found a cure, yet?" Vijay told him that they were unsuccessful, and the patients' conditions were aggravating. A streak of greed glimmered in Vayu's eyes as he realized that he was the only one with the cure. He started to imagine a life full of prosperity for Nandini. "I will get more medicine from the merchant. Just a sip of it will work but it costs 2 gold coins for every sip. Ask the ones affected to come to me for the medicine." Vayu gave a sip of the golden water to everyone in need, charging two gold coins each. Soon, Vayu had a sack of gold, and the flask of the holy water was empty.

Karma came to pay a visit to Vayu, as the day that the flask was empty, was when his wife Rekha fell prey to the disease. A distraught Vayu ran to river Jhanvi and pleaded her for more holy water. The serene river tinted with the green-yellow skies, rose and said, "I am sure, that the water you took last time could cure your wife. Let her sip that water." Vayu, ashamed to tell the river that he had made money by selling that water to those in need, quickly lied to her, "my daughter was very ill, and it took the whole flask to cure her." The river gleamed and gently whispered, "Very well, then. Take more water and do the same as last time. Your wife will be cured." Vayu followed her instructions, and Rekha was in full health the next day. Vayu was relieved, but his greed was still unsated. He continued to sell the holy water as medicine to those in need.

After a few days, Rekha screamed and Vayu came running to her aid. "Vayu, I cannot see anything. Everything is dark. What is happening to me?" yelled Rekha. Vayu was scared and suddenly heard a mob ragefully knocking at his front door. "Vayu, open up! The medicine you gave my daughter, it has turned her deaf." Said one of the villagers. "My husband has been paralyzed ever since he drank that medicine, what have you given us" shouted a lady. A terrorized Vayu bundled himself in a corner and realized what had happened. He was full of shame and guilt. That night, he made his way to the holy river again.

Vayu confessed his sins to River Jhanvi and begged for her forgiveness as he prayed for the health of his people. The river rose up and with a calm voice called out to him, "I know what you did Vayu. Since you lied to me and sold the holy water, your intentions were of greed and your soul was not pure. The second flask of water cured the villagers but also took something away from them. I am glad that you have realized your mistake. However, I do not have the ability to undo the sufferings, only God Shiva has that power. That night, Vayu prayed to Shiva. In his dreams, he caught a glimpse of Shiva creating the perfect Rangoli. Vayu knew that Shiva's Rangolis often reflected the God's temperament. He felt that this Rangoli was going to determine his fate.

The Rangoli sparkled with intricate designs of yellow and green. Shiva was content and joyous, and the earth's radiance expressed his emotions. Shiva forgave Vayu saying, "Vayu, to cure the ailing, cook with the river's water and feed the ones suffering for a few days, once you make up for your sins, their suffering will be undone."

Vayu followed Shiva's instructions, and hoped with all his heart that his wife and the villagers would be healthy and jovial again. Rekha's condition gradually improved as Vayu repented for his actions. With all the gold collected, he not only fed the ones suffering but the entire village itself. He prayed to the river and to the Gods for the health and happiness of his people, hoping for the unwell to recover soon.

Negative Affect Version

Vayu and Rekha were a happy and pious couple that lived in a village just off the banks of river Jahnvi. They worked as farmers and their wages were just about enough for them to live a comfortable life. Soon they were blessed with a baby girl, who they

called Nandini. Nandini was the heart and soul of her parents. The years went by, and the small family took care of the farms and made their living.

Vayu was a sincere devotee of God Shiva. He firmly believed in the scriptures that perceived the world as an image of Shiva's aura as they believed that the Earth's skies would shape themselves to reflect Shiva's emotions. They also stated that Shiva's Rangolis were a holy form of art as he often expressed his feelings through these Rangolis. Vayu's devotion towards Shiva was remarkable. Even on sad and stormy days like today, Vayu's prayers were not left unheard. On such days, the harsh and dark lands would fill the sky with a hint of red and blue, as they mimicked Shiva's Rangolis and his unpleasant mood.

Vayu was a sincere devotee of God Shiva. He firmly believed in the scriptures that perceived the world as an image of Shiva's aura. They talked at length about the God's holy art form of Rangolis and how Shiva often expressed his emotions through his art. They believed that the Earth's skies would shape themselves to reflect Shiva's temperament through the shades of his Rangolis.

Money was a never a problem with just Vayu and Rekha, but as Nandini grew up, Vayu wanted to provide her with all that she wanted and more. One night, Nandini started shivering, and she woke her parents up complaining. "Mother, I feel very cold and my body hurts." Vayu, panic stricken, took her to the village hospital where the doctors kept her overnight. As dawn broke, Nandini's condition worsened. The doctors tried to diagnose her all night but were unsuccessful. Heart-broken yet hopeful, Vayu took Nandini back home.

With all his determination, Vayu prayed to God Shiva for help. Shiva was at his abode, gazing at the vivid red and blue Rangoli he had just created. The heaven and the lands were catastrophic and gloomy as they symbolized Shiva's state of mind. The infuriating day was hindering Shiva's rationality, hence he asked the holy river Jhanvi to help his devotee instead. Jhanvi was born from the essence of God Shiva and thus, her personality, temperament, and powers were all an embodiment of the mighty God himself. Shiva told Vayu, "My child, I have heard your prayers. Go to river Jhanvi and ask her what you want. She will grant your wishes if your intentions are pure."

Vayu suddenly woke up and ran to the river in the dead of the night. He bowed down and prayed for Nandini's health. The holy river came to life and roared back, "Vayu, you have a clear heart and a pure conscience, take my water and tomorrow, let the first ray of light hit the water you have taken. The water will turn golden, ask your daughter to take a sip of this and her health will be restored." Vayu carried her water in his flask and followed river Jhnavi's instructions. At dawn, Nandini took a sip of the holy water and the color on her face immediately returned. She gained her health back in no time. Vayu and Rekha felt relieved and thanked the Gods and the river for their grace.

After a few days, Vayu headed out to the noisy and murky village market. "Vayu, how is Nandini now?" asked a familiar voice. Vayu turned to find his friend Vijay calling out. Vayu told Vijay that Nandini was doing well and that he had finally found a medicine that worked. He hid the details of his encounter with the river. "That is good news, Vayu. This disease seems to be spreading in the village". said Vijay. Vayu exclaimed, "that is terrible, have the doctors found a cure, yet?" Vijay told him that they were unsuccessful, and the patients' conditions were aggravating. A streak of greed glimmered in Vayu's eyes as he realized that he was the only one with the cure. He started to imagine a life full of prosperity for Nandini. "I will get more medicine from the merchant. Just a sip of it will work but it costs 2 gold coins for every sip. Ask the ones affected to come to me for the medicine." Vayu gave a sip of the golden water to everyone in need, charging two gold coins each. Soon, Vayu had a sack of gold, and the flask of the holy water was empty.

Karma came to pay a visit to Vayu, as the day that the flask was empty, was when Vayu's wife Rekha fell prey to the disease. A distraught Vayu ran to the river and pleaded her for more holy water. The agitated river tinted with the blue-red skies, rose and thundered, "I am sure, that the water you took last time could cure your wife. Let her sip that water." Vayu, ashamed to tell the river that he had made money by selling that water to those in need, quickly lied to her, "my daughter was very ill, and it took the whole flask to cure her." The dark river mysteriously whispered, "Very well, then. Take more water and do the same as last time. Your wife will be cured." Vayu followed her instructions, and Rekha was in full health the next day. Vayu was relieved, but his greed was still unsated. He continued to sell the holy water as medicine to those in need.

After a few days, Rekha screamed and Vayu came running to her aid. “Vayu, I cannot see anything. Everything is dark. What is happening to me?” yelled Rekha. Vayu was scared and suddenly heard a mob ragefully knocking at his front door. “Vayu, open up! The medicine you gave my daughter, it has turned her deaf.” Said one of the villagers. “My husband has been paralyzed ever since he drank that medicine, what have you given us” shouted a lady. A terrorized Vayu bundled himself in a corner and realized what had happened. He was full of shame and guilt. That night, he made his way to the holy river again.

Vayu confessed his sins to River Jhanvi and begged for her forgiveness as he prayed for the health of his people. The river rumbled, “I know what you did Vayu. Since you lied to me and sold the holy water, your intentions were of greed and your soul was not pure. The second flask of water cured the villagers but also took something away for them. I am glad that you have realized your mistake. However, I do not have the ability to undo the sufferings, only God Shiva has that power. That night, Vayu prayed to Shiva. In his dreams, he caught a glimpse of Shiva creating the perfect Rangoli. Vayu knew that Shiva’s Rangolis often reflected the God’s temperament. He felt that this Rangoli was going to determine his fate.

The Rangoli glared with intricate designs of red and blue. Shiva was vexed and displeased, and the earth’s somber skies expressed his emotions. Shiva scolded Vayu for his sins, but took pity on the victims of Vayu’s doings, “To cure the ailing, cook with the river’s water and feed the ones suffering for a few days, once you make up for your sins, I will see if the suffering can be undone” said Shiva.

Vayu followed Shiva’s instructions, and hoped with all his heart that his wife and the villagers would be healthy and jovial again. With all the gold collected, he not only fed the ones suffering but the entire village itself. He prayed to the river and to the Gods for the health and happiness of his people hoping for all the unwell to recover soon.

Appendix C. Interview Questions

Story Comprehension Questions

1. In your own words, what were the stories about? How did they end?
2. Would you please speculate on what might happen next in the stories?
3. Was there any point where you felt distracted/confused?

Engagement & Motivation Questions

4. Were you engaged and or immersed in the experience?
5. What connected/immersed you most to the experience?
6. Did you listen to both stories all the way through? Why or why not?

Mental Model Questions

7. How do you think the system works?
8. Describe to me the behavior of the system?
9. How did you interpret the mapping of the Rangolis?
10. How long did it take you to figure out this mapping?

Ambience Questions

11. Was there a relationship between the mood you created and the story content?
12. At any point, did you perceive any mismatch between the story content and the ambience?
13. Were the stories happy or sad? Why? What was the overall mood of the experience?
14. What was your emotional response to the moods you created in the tent?

- a. Do ambiences map to moods? Did the sad ambience make you feel sad?
- b. What did setting up an ambience do for you? Set emotional context? Just drive the narrative? Means to decision making? Or something else?

Decision Making and Choice Questions

- 15. Describe your decision-making process when selecting Rangoli?
 - a. Did you try to use the Rangoli to direct the outcome of the story?
- 16. Did you feel like you were given narrative choices by the system?
 - a. (If yes) How did you feel about those choices?
- 17. Do you think the story would be different if you experienced it a second time, and made different choices?
- 18. Do you feel like the ending reflected your choices with the Rangoli?
- 19. What kind of ending did you expect from the story?

Character Identification Questions

- 20. Which of the characters, if any, did you relate most closely too?
- 21. What do you think your role was within the experience?

Cultural Interface Questions

- 22. Tell me what you think a Rangoli is.
- 23. Did the Rangoli interface feel comfortable or uncomfortable? Did it feel familiar or strange? In what ways?
- 24. What kinds of values or assumptions can you imagine about the culture that produced this interface?

25. How did you feel about interacting with a culturally specific system?
26. What would you take away regarding Indian mythology / culture / art after this experience?

Story Authoring Questions

27. Were you motivated to record your own story ending? Why or why not?
28. (if yes) what ambience did you create while authoring and why?
 - a. What art did you create?
29. What motivated you to listen to other's stories?
 - a. (if yes) What did you think about the other stories?

Design Questions?

30. Is there anything you would like to change about this experience?
31. How else would you use this system?