

i-Theatre: Tangible Interactive Storytelling

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Abstract. Storytelling is fundamental for the cognitive and emotional development of children. New technologies combined with playful learning can be an effective instrument for developing narrative skills. In this paper we describe i-Theatre, a collaborative storytelling system designed for pre-school children: with it, it is possible to use characters and scenarios drawn on paper for creating a digital story, using simple animation techniques and recording voices and sounds. For implementing it, we combined a multitouch surface with a set of tangible objects. This choice allowed lowering the learning effort of a new interface, letting the child to be immersed directly into the storytelling process from the very beginning.

Keywords: Storytelling, multitouch, children, education, tangible technologies, collaboration.

1 Introduction

Pedagogists universally agree on the fundamental role that storytelling plays in children's growth: not just listening to stories in early age is important for oral language development, but also encouraging children to tell their own stories help them to learn how to effectively use the language and to structure their thoughts. New media and interaction technologies can be used as facilitator for eliciting children telling their own stories and developing narration skills.

During the last years, various researchers proposed different approaches to technology-mediated children storytelling. In an early work, Cassell et al. [2] created Rosebud, a computationally-augmented toy to which the child could tell their stories, thus using a familiar mode of interaction for encouraging children to write, edit, collaborate, and share their stories. This work demonstrated the enormous potential of using tangible and natural interfaces for introducing children to technologies.

More recent works by various authors used a great variety of technologies for supporting children's story creation and expression. For example, Sugimoto et al. [1] proposed GENTORO, a system thought for elementary age children based on a robot and a handheld projector, while Cao et al. [4] proposed TellTable, a multitouch surface system. Fails and Guha [3] created Mobile Stories, an

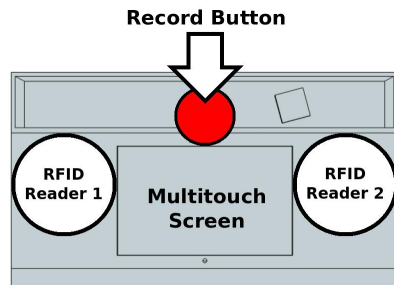
application designed for mobile devices for creating cooperative *shared narratives*. In our previous work [6], we used hand puppets as tangible interface for creating a fully immersive storytelling experience. Finally, Botturi and alt. [5] used various technologies as instruments for motivating children with special needs to participate to creative activities and for expanding children’s expressive choices.

In this paper, we present i-Theatre, a system for storytelling designed for one or two kids who can collaborate for creating, storing and sharing their own stories in a multimedia format. i-Theatre was created using the combination of two main technologies: a multi-touch surface and tangible objects. It looks like a coffee table with a integrated multitouch surface (*Fig.1a*). The table embeds also a scanner, two Radio Frequency Identification (RFID) readers *Fig.1b*, microphone and speakers and a set of tangible objects (*Fig.2a* and *Fig.3a*). All this elements provide an abstract layer to use the system thus providing an engaging and easy to use interface.

Our system was conceived for developing narration skills in children in the last year of preschool. While most of the previous works target elementary school children, a smaller number are dedicated to younger children. For this reason a special attention to the needs and skills of our very young users have been taken into account during the system design. The graphical user interface used in the multitouch surface is essential and very intuitive, based on very few elements, while the interaction is mainly achieved through the use of tangible objects. Research conducted by Xu and alt. [7] on the use of Tangible User Interfaces (TUIs) in assisting childrens learning highlighted the little time needed for learning this type of interfaces, due to our inborn ability to manipulate objects tangibly with little cognitive effort. The choice of using a TUI in i-Theatre a as main interaction tool is therefore motivated by our intend of immersing directly the child into the storytelling process, avoiding the initial difficulty of learning a new interface, and at the same time providing an enjoyable environment together with the necessary tools for expressing thoughts and experiences.



(a) i-Theatre prototype



(b) i-Theatre table surface

Fig. 1. The i-Theatre table

2 The i-Theatre Storytelling Process

The aim of the system is to stimulate the child to tell tales using a gradual approach. The first impact with the i-Theatre table is typically very playful: children experiment moving characters around the tangible surface, resizing and rotating them. Then they start creating stories: at the beginning very simple, composed by one single scene; as they get more confident with the system and their own narration skills, stories get more and more articulated, composed by several scenes. A typical story creation process using i-Theatre goes through five stages, each one of them has associated a number of tangible objects:

Stage 1: Creating and saving the story elements

Initially children are invited to create the characters and backgrounds for their story: they can draw on paper their own story elements using various techniques, select them from books, create collages or use small objects. The selected material is then digitalized as pictures that are visualized on the multitouch surface. Eventually, they can be stored for later using their own *Personal Archive*, a tangible object that represents their own personal space where to store all the created content (*Fig.2a*). At this stage, children is free to explore the system and get familiarized to it: characters can be moved around the surface, be resized and rotated.

Stage 2: Selecting the elements for the story

When the child is ready, he can select the audio-visual elements that will be used for telling the story from his *Personal Archive*. All the choosen elements will be available later on, during recording.

Stage 3: Telling the story

For starting the registration the children plugs the *Scene Container* (*Fig.3a*) into the table: at this point the system is ready to acquire a scene of the story. A *Record Button* is used for starting and stopping the recording session: when it is pressed, all the drawings' movements and animations are grabbed and voices and sounds recorded by the microphone. During the narration *characters* can be dragged in or out the backstage. Then, when the *Record Button* is pressed again, the *Scene Container* will contain a part of the story. Additional scenes can be created by introducing new empty containers.

Stage 4: Select the definitive story order

After that all of the scenes have been recorded, a complete story can created by plugging the *Scene Containers* to each other. The story sequence is defined by the *Scene Containers'* plugging order (*Fig.3b*), since there is a direct relation between each tangible object and a piece of story. *Scene Containers* can be plugged into different sequences or substituted to obtain new stories.

Stage 5: Storing the story

When the story is finished the kid can save the created movie inside his *Personal Archive* and watch his story later.

It is not necessary to perform all these phases sequentially from beginning to the end: for example the children can start from already available content stored in the system, such as backgrounds or scenes, or can go back and through from one stage to another for adding a missing part or refining their work.

3 Operation Modes

The i-Theatre system is characterized by different states or operation modes, each of them is related to different moments in the story creation process. A system state is determined by the set of tangible object in use: thought the manipulation of these objects it is possible to switch between different operation modes, thus avoiding the use of a GUI (Graphical User Interface) based menu. These operation modes are listed below:

- *Exploration Mode*: in this operation mode no tangible objects are used. Children can explore and familiarize with the system, moving and playing with the characters on the surface. It is possible acquire new visual content, such as hand made drawings or printed photos, using the scanner embedded into the table.
- *Creation Mode*: children can browse and select stored multimedia material or save new one. The *Creation Mode* starts when at least one *Personal Archive* is placed over the reader (see *Fig.2b*)
- *Action Mode*: in this operation mode it is possible register a scene of the story. This mode starts when a kid plugs the *Scene Container* (see *Fig.3*) object.
- *Production Mode*: allows children to determine and change the event order on a story. When a kid wants create the story sequence, he must chain some *Scene Containers*.

4 Tangible Interface

For supporting the story creation processing, a set of tangible objects have been introduced and integrated into the system.

- A scanner embedded in the i-Theatre table offers a simple method for digitalizing visual content. A picture can be scanned as a *character* or *backdrop*: in the first case, it can be rotated, moved or scaled, while in the second case the image remains fixed on the background. The selection of the image use is done just before picture acquisition, when the scanning command is given.

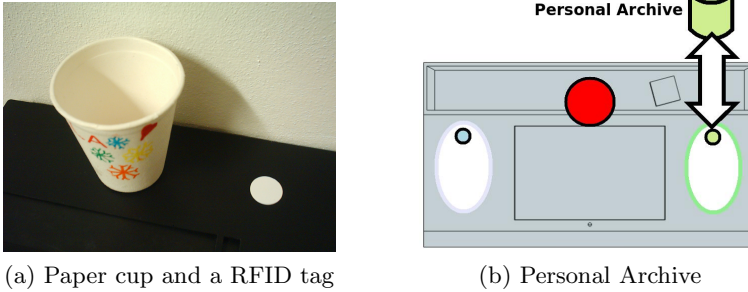


Fig. 2. (a) For this prototype, paper cup has been used like a metaphor of Personal Archive. Each cup is identified by an RFID tag. (b) Placing the Personal Archive over an RFID reader, the screen shows the content.

- The *Personal Archive* serve as interface for entering into the *Creation Mode* and for storing multimedia content into a personal space. It uses RFID (Radio Frequency Identification) technology for identification thus providing a low-cost and contact-less interface for organizing content: each child has her own identifier associated to an RFID tag, that is attached to a personal object that can be an artifact created by the child (e.g. a decorated paper cup) or any other personalized item. The *Personal Archive* is used for associating the child’s identifier to the selected content: when it is put on the reader, the kid can view his own stored images or store new ones. Two RFID antennas installed beneath the table top allow access from any side of the table *Fig.1b* and consent up to two kids to store or select multimedia items simultaneously.

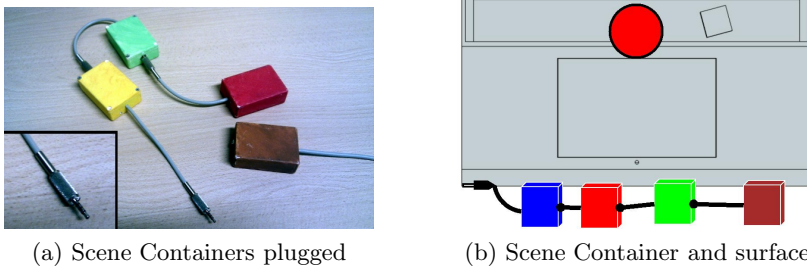


Fig. 3. (a) The Scene Container is a colored box with a male and female jack connectors to allow cascading between them. (b) The cascaded Scene Containers can be connected to the table in order to obtain the desired story order.

- The *Scene Containers* *Fig.3* consent to enter into the *Action Mode* and each of them can be used for storing a single scene of the story. This tangible object contains an unique identification code (ID) that the system associates

to a recorded scene. For the implementation of the *Scene Containers*, customized hardware was designed instead of using RFID technology. This because we needed to obtain the ordered sequence of IDs from the cascaded plugged objects, for being able to read the correct order of story scenes.

5 Conclusion and Future Work

We plan to conduct extensive user studies of the usage of the i-Theatre prototype by preschoolers to test such questions as how i-Theatre usability can be improved, how well i-Theatre elicits storytelling in children, and if its usage in a classroom and in a museum laboratory contexts can be successful.

The first tests conducted are encouraging and showed that in the studied cases the chosen approach is effective in engaging children and motivating them in experimenting different storytelling solutions. Children not only showed interest in creating their own stories but also explored the available tools for improving their narrative. We used these experiences for improving the initial research prototype, in an iterative cycle of development and re-design of system. Finally, thanks to the input from teachers, we identified new features to be implemented for better supporting classroom activities in a flexible way. The i-Theatre is continually in evolution, making technology funny and accessible for the youngest.

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