

# t-stories: Improving and Expanding t-words

**Joaquim Dantas**

School of Technology  
Polytechnic Institute of Cávado  
and Ave  
Barcelos, Portugal  
a6868@alunos.ipca.pt

**Cristina Sylla**

CIEC - engageLab  
University of Minho  
Braga, Portugal  
sylla@engagelab.org

**Pedro Branco**

Algoritmi - engageLab  
University of Minho  
Guimarães, Portugal  
pbranco@dsi.uminho.pt

**Vítor Carvalho**

School of Technology  
Polytechnic Institute of Cávado  
and Ave - Algoritmi  
University of Minho  
Barcelos-Guimarães, Portugal  
vcarvalho@ipca.pt

**Eva Oliveira**

Digarc - School of Technology  
Polytechnic Institute of Cávado  
and Ave  
Barcelos, Portugal  
eoliveira@ipca.pt

## ABSTRACT

This paper describes the reengineering t-words, a tangible interface that aims at promoting children's collaborative and playful exploration of the oral language. t-stories, the new version of the interface, is composed by 10 client modules and a server module; each module has a slot on the top surface for placing paper cards (that can be customized) and a surface for drawing on the bottom. t-stories allows recording and reproducing audio as well as drawing, or writing on its surface. Additionally it allows recording and playing audio based on NFC tags, which can be stuck to different surfaces or objects, and used in various scenarios, e.g., record a story on a tag and stick it to a drawing. Children can use the interface to carry a wide variety of language related activities, and choose how they want to hear them (e.g., specific sequences or the whole story). This paper describes the new implementation of the interface and presents an intervention that was carried at kindergarten with a group of 18 children, aged between five and six years old.

## Author Keywords

Tangible Interfaces; Story Listening System; Children; Exploration; Emergent Literacy; Phonological Awareness.

Permission to make digital or hard copies of part or all of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for third-party components of this work must be honored. For all other uses, contact the Owner/Author.

Copyright is held by the owner/author(s).

ACE '15, November 16-19, 2015, Iskandar, Malaysia

ACM 978-1-4503-3852-3/15/11.

<http://dx.doi.org/10.1145/2832932.2832940>

## ACM Classification Keywords

H.5.2 Information Interfaces and Presentation (e.g., HCI): User Interfaces, user-centered design. K.3.0 [Computers and Education]: General.

## INTRODUCTION

This study builds on prior work by [7,8] and aims at redesigning the original interface extending its affordances and simultaneously reducing its cost. In fact, while the original interface underwent several optimization cycles, the new version, t-stories has drastically reduced the production price, bringing the technology one step near to the potential users. Building on the flexibility and potential of the original interface to support a wide variety of pedagogical and playful activities, this new approach extends the kind of activities that can be carried with the interface. t-stories maintains the philosophy from the original interface that it does not depend on a computer device, empowering users to create their own activities.

## THE IMPORTANCE OF LISTENING SYSTEMS

t-stories is part of the "story listening systems" [3], as these systems are non-screen-and-keyboard-based technologies, they naturally lead users to concentrate on the audio component of the language. Therefore, having the potential to foster early literacy skills while promoting phonological, lexical and metalinguistic awareness. Phonological awareness refers to the ability of identifying and manipulating units of oral language, such as words, syllables, onsets and rimes; lexical awareness is the knowledge of vocabulary; and metalinguistic awareness is the ability to reflect about the language itself. While all these skills influence children's acquisition of early literacy, children's phonological awareness is directly related with

their successful learning of reading and writing [5,9] due to the relation that exists between the alphabetical written code and the phonological component of the oral language [1].

### BACKGROUND AND RELATED WORK

t-stories aims at promoting children's collaborative playful exploration of the oral language, by allowing them to create a wide diversity of language related activities. Other examples of story listening systems are TellTale [2], StoryMat [4], t-words [7,8], or Jabberstamp [6]. TellTale has the form of a centipede and allows children to record audio into each part of the body, and hear it by pressing a button. The pieces are independent of each other and can be randomly sorted and rearranged. StoryMat consists of a soft play mat with sewed objects where children can play using stuffed toys. The gestures and the story told by the child on the mat are recorded and then compared with stories from children that have previously played on the StoryMat. The story with a similar pattern is then recalled and played, acting as inspiration for the creation of new stories. Jabberstamp [6] allows children to enhance their narratives by adding sounds and voices to their drawings. The drawings, collages or paintings are created on a layer of paper placed on a Wacom tablet; by pressing a special rubber stamp on the paper, children can record sounds into their drawings, and hear them by touching the marks of the stamp with a small trumpet. t-stories consists of rectangular blocks in which children can record audio. The blocks can then be snapped together playing the recorded audio in a sequence; by reordering the blocks in different ways the audio sequence changes according to the order of the blocks. Additionally children can personalize the blocks by drawing on its surface.

Despite their potential to engage children in playful literacy related activities, some of these story listening systems are quite complex to set up and use on a regular basis in real world settings (e.g., StoryMat) especially with children users robustness and ease of use are core issues; also, some of the referred interfaces are still conceptual prototypes. t-stories brings together the different characteristics present in the above referred interfaces, allowing recording and playing in different modules that can then be snapped together (TellTale, t-words), as well as drawing (TellTale, t-words, Jabberstamp) but also listening to the different recorded modules independently. As described in the following section, besides recording and playing audio through each module, the interface allows recording (and playing) using identification based on NFC tags that users can stick on objects, paper, or other materials.

### THE T-STORIES SYSTEM

The actual t-stories system is composed by 10 client modules and a server module; each module has a slot on the top surface for placing paper cards and a surface for drawing on the bottom (fig. 1). The client modules have magnets on each side to connect to each other and to the

server module. To record on a client module, users place the server module over it and record while pressing a button (fig. 2).



Figure 1. Child drawing on a t-stories module (left), module with card and child holding the server module (right).



Figure 2. Child holding the server module over a client module to record audio.

To play the recorded audio users connect the client modules to the server, which plays the audio from left to right, or alternatively, users can hold the server module over the client modules to hear the corresponding audio.

Additionally t-stories allows recording and playing sounds using identification based on NFC tags that can be placed as stickers on objects, paper, or other materials.

### Technical Description of the System

The hardware modules included in the t-stories system are of two types: the server module and the client modules. The server module has specific hardware for recording audio, such as speaker, processing unit, data storage and communication interface (NFC, serial) (fig. 3). The hardware of the client modules includes a processing unit, a serial communication interface and an NFC tag with the module identification (fig. 4).

Every recorded sound is saved and stored in a flash drive with a micro-USB interface, which can be directly connected to the server module. Each file has a unique ID, making it possible to access every audio file recorded in a

NFC tag. The firmware update is done automatically and wireless through the flash drive.

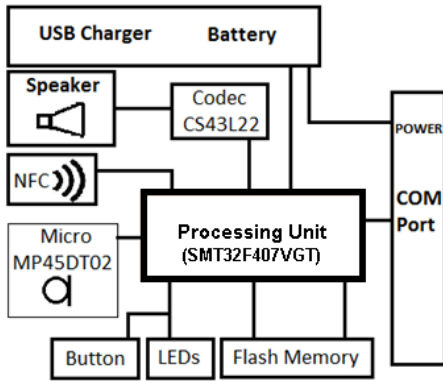


Figure 3. Block diagram of the components of a t-stories' server module.

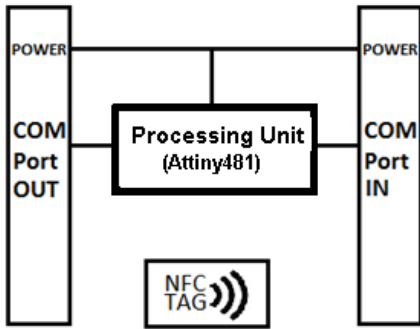


Figure 4. Block diagram of the components of a t-stories client module.

All components were selected with the aim of reducing the final cost of the system. The number of components included on the client modules was reduced to the minimum possible in order to reduce the final cost of the modules.

### CHILDREN'S WORKSHOP

In order to assess the ease of use of t-stories as well as to which extent the new version of the interface was able to promote engagement and creativity, the researchers carried a workshop at a kindergarten with a group of 18 children aged 5 to 6 years old. The intervention took place in children's room. The researchers began by presenting the activity to the whole group, and then the teacher and the children left the room and went to play outside, so that the intervention could be performed with small groups of six children each.

The researchers began the activity with the small groups (six children at a time) by showing the interface to the children. One of the researchers exemplified how to record and play audio with t-stories, by recording audio into a t-stories module and then placing the server module over it to play the recorded sound. After assuring that all children had understood the functioning of t-stories, each child got a t-

stories unit and experimented with recording and playing some words/sounds/songs.

### Proposed Activity

After the first exploration the researchers proposed a language game to the group, in which children were asked to create rhymes. The rhymes were inspired by a set of paper cards with drawings representing a wide variety of elements. To add some surprise to the game, the cards were in a bag, and each child could take two, but choose the one s/he liked more. Each child also got a t-stories unit, and inserted the card on his/her module (fig. 5). After that, each child was asked to create a rhyme based on his/her card. After some brainstorming within the group each child recorded a sentence.



Figure 5. Child placing a card on a t-stories module.

Afterwards, the children connected their units (client modules) to the server module and listen to the sequence of recordings (fig. 6).



Figure 6. Children playing the recorded audio sequence by connecting the clients to the server.

Alternatively, children could just hold the server over a particular client module and listen to it (fig. 7). Children were also told that they could change the sequences of the client modules and create different rhymes and stories.

To finalize the activity children were asked to explore playing different sequences with the client modules (fig. 8).



**Figure 7. Children holding the server over the clients to play the recorded audio.**



**Figure 8. Children experimenting with different sequences.**

Children also engaged with drawing on the surface of the t-stories client modules, spending a considerable time with this activity (fig. 1). Actually the researchers had not planned that the second group would also draw (as the activities with the first group extended a bit too long), but the children were very eager to draw and insisted on doing it.

### Observations

Children were very engaged with the activity of recording and listening to their own voices. They were highly motivated when recording their rhymes, regardless of its content, and eager to listen to the output. It was with some difficulty that they passed along the server module to their teammates, and sometimes the moderator had to intervene in order to proceed. It was also interesting to note that some children began to sing instead of speaking. The first group of children spontaneously named the server module “the machine”; as this gave some information about how children perceived the t-stories interface the researchers asked the following groups how they would call it; the second group named the server “recorder” and the third “radio”. Children considered the server module the most interesting piece of the interface, and liked specially to hold it over specific client modules to hear the recorded content. Some children spontaneously stated they wanted to hear a

certain client module, e.g., one of the boys said “*I want to hear the ball again*”. Children seemed to prefer this feature (to hold the server module over the clients to hear) rather than hearing the client modules by connecting them to the server. In fact, they never used that feature spontaneously.

Drawing was another activity that children enjoyed very much, probably because the drawing was linked to their recordings. Relatively to the recording the researchers observed that it was difficult for the children to press and hold the recording button, which led them to redesign this feature. The next version (already under development) will record by pressing a button, while a green light gives feedback about the recording; to stop recording users press the button again.

### Children’s Opinions

At the end of the activity children were asked about what they liked most. They told that they liked saving their stories and hear them later. Some suggested they would like to take t-stories home to capture the sound of their pets, their siblings, to record what they had learned and also to sing.

### INTERVIEWING THE TEACHER

The teacher considered the tool very flexible and said that it would support a wide range of different activities. In her words: “*You just need to let your imagination go, and be creative, as there are so many activities that we could do with such tool*”. She envisioned some scenarios, such as:

- Telling stories in the round, phonological games or singing songs.
- Recording the clients with identification based on NFC tags and use them together with children’s drawings, e.g., children could complement their drawings with audio;
- Create a board where children stick tags with their personal recordings that they could hear throughout the year (based on different themes).
- Create a treasure hunt with tags with the recorded instructions placed in strategic objects, and so on.

### DISCUSSION AND CONCLUSIONS

t-stories has shown to have the potential to be used in real world settings, allowing children/teachers to create a wide range of activities. As revealed in the intervention, the handling of the modules promoted collaboration, while it also required negotiation as children had to share the server module and to agree on the sequences they wanted to hear. The teacher considered that the interface was very flexible and intuitive allowing the customization of different activities. Relatively to the cost optimization of the system, the new version considerably reduced the production costs, while adding new features to the system e.g., the implementation of the NFC tags, which allow a great number of different activities, as well as the two different modes of playing the recorded audio on the client modules.

## ACKNOWLEDGMENTS

We thank the kindergarten *Bogalha* in Braga-Portugal, the children and their teacher for their wonderful collaboration in this study. This work was partially supported by FCT - Portuguese Foundation for the Science and the Technology- within the Projects: UID/CED/00317/2013 and UID/CEC/00319/2013.

## REFERENCES

1. Adams, M.J., Foorman, B.R., Lundberg, I., Beeler, T. 1998. Phonemic awareness in young children: A classroom curriculum. Brookes Publishing Co.
2. Ananny, M. 2001. Telling Tales: A new toy for encouraging written literacy through oral storytelling. In Proceedings of the Biennale Conference Society for Research in Child Development. Minneapolis
3. Cassel, J. 2004. Towards a model of technology and literacy development: Story listening systems. *Journal of Applied Developmental Psychology*, 25, 75-105.
4. Cassell, J. and Ryokai, K. 2001. Making Space for Voice: Technologies to Support Children's Fantasy and Storytelling. *Journal of Personal Technologies*, 5, 3, 203-224.
5. Perfetti, C.H., Landi, N., Oakhill, J. 2009. "The Acquisition of Reading Comprehension Skill", *The Science of Reading* (3rd ed.), M.J. Snowling, C. Hume, (eds). Blackwell Publishing, 227-247.
6. Raffle, H., Vaucelle, C., Wang, R. and Ishii, H. 2007. Jabberstamp: embedding sound and voice in traditional drawings. In Proceedings of the International SIGGRAPH Conference on Computer Graphics and Interactive Techniques, (SIGGRAPH '07) 137-144.
7. Sylla, C., Gonçalves, S., Branco, P., Coutinho, C. 2012. t-words: Playing with Sounds and Creating Narratives. In A. Nijholt, T. Romão & D. Reidsma (eds.), Proceedings of the 9th International Conference on Advances in Computer Entertainment Technology, ACE'12, Kathmandu, Nepal, November 3-5, 565-568. Lecture Notes In Computer Science, Springer. DOI: 10.1007/978-3-642-34292-9.
8. Sylla, C., Gonçalves, S., Branco, P., Coutinho, C. 2013. Peter Piper Picked a Peck of Pickled Peppers - an Interface for Playful Language Exploration. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '13), 3127-3130. doi:10.1145/2468356. 2479627.
9. Whitehurst, G.J., Lonigan, C.J. 1998. "Child Development and Emergent Literacy", *Child Development*, 69, 3, 848-72.