Tangible Message Bubbles for Children's Communication and Play

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Abstract
We introduce *Tangible Message Bubbles*, a new composition and communication tool that invites youngsters to express and record their everyday expressions, play with these original recordings, and share these personal creations with their friends and family. We present a design rationale that focuses on supporting both co-located and remote collaboration, and on balancing play with tool design. Results from pilot evaluations with our initial prototypes informed us with ways to leverage the physical properties of the toys and support playful exploration of children's recorded video messages for sharing.

Keywords
Tangible, children, communication tools, toys,

ACM Classification Keywords
H.5.1 [Information Interfaces and Presentation]: Multimedia Information Systems—artificial, augmented, and virtual realities.

Introduction
Many young children today have family members who live far away from them. While existing communication tools such as telephones, cell phones, and video conference tools can help families communicate over a

figure 1: Accordion with a receptacle in which a child can stick his/her head in to record a message. The bellows allows the child to manipulate the recorded video.

figure 2: Balloons, in a droplet (L) and bubble (R) shape have a pushbutton ring at their opening to detect a user's face against the balloon. It houses the force sensor, camera, and an LED.

distance, traditional and screen-based communication tools do not always work well for young children. Children under age 7 often have trouble using audio-only tools like telephones, and video based tools do not leverage hands-on multimodal interactions that are known to foster children's learning and communication. In general, young children's reliance on interaction with physical objects is poorly supported by common communication tools.

Our goal is to invent new tangible communication tools for young children that combine state of the art communication technologies with the physicality, simplicity, and immediacy of children's toys. This paper reports *Tangible Message Bubbles*, a system that invites youngsters to express and capture their everyday expressions (e.g., oral greetings & storytelling, signing, making funny faces, blowing kisses, etc.), play with these original recordings, and share these personal creations with their friends and family.

Design Principles

Our early informal observations of children's interaction with commercially available communications technologies and services have guided the following design principles for Tangible Message Bubbles.

Make interactions concrete

We aim to design tools that do not rely on fluency with the traditional desktop environment (e.g., use of a mouse and a keyboard) as young children do not use these devices as adults do. We focus on oral language as the primary mode of communication for our pre-literacy children. Our particular designs address our observations that youngsters are fascinated with recording their voices and faces, but it is difficult for children to edit or manipulate recorded messages in any way.

Support kinesthetic interactions

Although the GUI was envisioned to support interaction through physical doing ("enactive representations") [5], using a mouse is an extremely limited and fine-grained form of kinesthetic interaction. We are working to provide tools that leverage children's kinesthetic intelligence [3], inviting both fine and gross motor skills for interaction. Our designs build on themes of direct manipulation [7] and classic play patterns from toy design. Tangible Message Bubbles are designed to allow children to tangibly create, manipulate, and share recorded messages of themselves through combinations of different fine and gross physical interactions with the interfaces.

Create real-time systems

Tangible and digital systems must share the immediacy, responsiveness and consistency of interaction with physical objects. Refresh rates of digital systems must exceed human perceptual limits (i.e. 30-60Hz for video, low latency in sensor systems) and be technically reliable. Although digital signal processing techniques are often chosen to mimic the behavior of physical systems, consistent and immediate performance allows the designer to have some liberty in her choice of synthesis and mappings.

Support co-located and remote communication

An attempt to open a long distance communication channel may not always result in a successful handshake. E.g., when the child is attempting to communicate with his/her relatives over distance, the

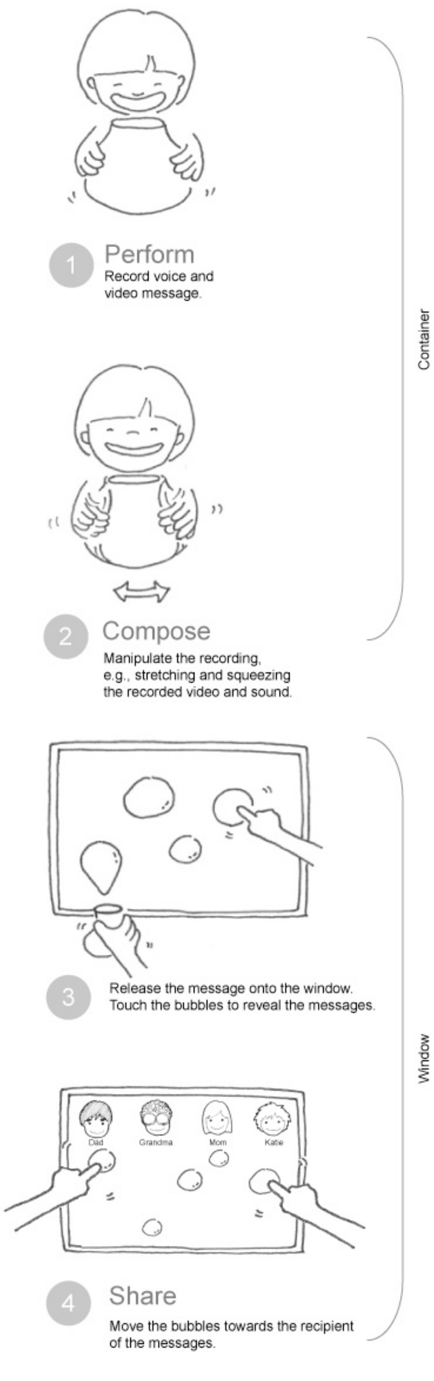

figure 3: Tangible Message Bubbles interaction flow.

recipient of the message may not be immediately available to receive the message. Our tools are designed not only to open a live communication channel, but also to be fun toys for children to express themselves and play both alone and with friends in co-located groups. We are striving to create tools that support: individual play, collaborative play, and both synchronous and asynchronous play with remote partners.

Tangible Message Bubbles

We have designed 1) a set of tangible *containers* and 2) a *window* for children to capture their expressions through voices and facial expressions, and manipulate these expressions in a physical manner to share them with their friends and family.

The Containers

The containers are physical repositories for children to capture and control audio and video messages of themselves. Sticking one's face into a container triggers a recording of one's face, and retracting one's face stops the recording. Squeezing and stretching the container releases the content (i.e., the video recording) with varying playback that matches the container's physical manipulation. For example, squeezing a container quickly may cause its contents to emerge faster (increasing speed and pitch of video playback), or vibrating the container in one's hands may create a vibrato effect with one's voice playback.

We are currently experimenting with two different designs for the containers: an Accordion and a Balloon. The Accordion [see figure 1] has similar affordances as a real child-sized accordion. One side of the accordion has a receptacle in which a child can stick his/her head in to record a message. The bellows allows the child to manipulate the recorded video (e.g., move the bellows slow to create low-pitched playback and fast to create high-pitched playback). The Balloon is a silicone bubble container, which is squeezable [see figure 2]. Like with the accordion, the placement the face (i.e., touching the ring at the opening) triggers the video recording. Once the recording is made, the container itself can be squeezed with varying speeds to release the video at different rates.

The Window

The window is where the content of the containers can be released. When the container is near the window and the container is squeezed, its content will be released onto the window as a flowing bubble. The children may touch the bubble and reveal the content, sort several messages to be sent to a specific recipient. For example, dragging a couple of speech bubbles into the "Grandma's door" at the edge of the frame, sends the video messages to the child's grandmother as an email attachment [see step 4 of figure 3]. We are currently exploring two types of designs for the window. One is a "bulletin board" style asynchronous communication forum where children leave messages and the recipient would receive the message as they are sent (e.g., via email and MMS). The second design uses the window as a two-way communication forum that informs if the remote person is online and allows a two-way real-time communication.

Related work

Tangible container metaphors have been explored in the past. Our tools add an element of digital manipulation that is controlled by physical manipulation of the container itself.

MusicBottles [4] are transparent glass bottles that trigger the playback of audio recordings when they are placed on a special table and have their corks removed. They presented the concept of a physical container for digital information. Our work builds on such a metaphor, allowing users to add their own contents to such a container and physically manipulate the container itself to manipulate its contents.

ScreamBody [2] is a human organ shaped portable container that allows a person to scream into the container privately in places where it is not permitted. ScreamBody also records the person's scream for later release at the time of the person's choosing. ScreamBody became our inspiration for a container of children's voices. In addition to providing a physical container for ephemeral oral messages, we wanted to allow interesting manipulation enabled by the mechanical properties of the container such as squeezing and stretching.

Slurp [8] is a tangible eye-dropper with simple haptic and visual feedback that can "pick up" and "release" pointers to networked digital content. In one example, Slurp was used to move videos between video displays. Slurp is presented as both a container and a tool, although it is not used to manipulate the digital content in a continuous and dynamic ways.

Researchers have explored tangible tools for children to record and compose their recordings. TellTale is a toy caterpillar with modular body components that invites children to record short messages and story segments [1]. Children experimented with different orders and arrangements of their oral recordings. By giving tangible forms to oral messages, TellTale gave young children concrete tools to edit oral messages.

I/O Brush is a physical paintbrush equipped with a video camera and sensors, to explore colors, textures, and movements found in everyday materials by "picking up" and drawing with them [6]. I/O Brush has a history mode that records video and audio before and during the capturing process. The children who used I/O Brush used the history mode to capture their singing voice and story segments and weaved them into their painting.

System implementation

Software

For each toy we use software to map the child's interaction with the toy to the playback of the child's recording. Arduino2Max firmware on the Arduino board captures and sends values from each toy's sensors to Cycling '74's Max 5 programming environment. Custom patches in Max use the MSP and Jitter components for audio and video processing and playback. Audio and video is in sync during playback.

For the accordion, values captured from the potentiometer control the position, direction, and speed of the recording's playback. When the child opens the accordion, spreading his/her arms apart, we capture the potentiometer's value (the distance of the accordion's span) and map it to a position in the recording. Closing the accordion creates increasing values on the potentiometer, and the Max patch plays the recording forward. Opening the recording plays the recording backward. The faster the child opens or closes the accordion, the faster the playback. When the child stops opening or closing the accordion, playback

figure 4: Children playing with the accordion and the balloon.

stops as well. On continuing opening/closing, the playback continues where it left off. Thus the child is able to select a portion of his/her recording and effectively loop it over and over by opening and closing the accordion.

For the balloon we capture values from the custom FSR to control the start and speed of the recording's playback. Lightly squeezing the balloon starts playback from the beginning of the recording. A rapid change in pressure on the FSR results in the recording played back at a faster rate. Due to its small size and higher level of user precision required, manipulating the balloon does not affect the direction and position of recording's playback.

Hardware

ACCORDION

Paper bellows are fan-folded around a cardboard frame, with a composite container affixed to one side of the device. A scissor-linkage is hidden inside the accordion body, and the accordion's "openness" is measured by placing a potentiometer in one joint of the scissor. The composite container houses a USB video camera, a microphone, a high-brightness white LED, and a button, which detects if the container is opened or closed.

BALLOON

A flexible silicone vase can be configured into either a bubble or a droplet (figure 2). The vase is fitted with a pushbutton ring at its mouth to detect if a user's face is pressed against its opening. Inside the vase we have hidden a video camera, LED, and a custom FSR that measures how the bubble's equator is being deformed by the user. Each toy is a standalone system composed of the toy wired to a dedicated computer and monitor.

Evaluation

We are currently in Phase I of our initial evaluation. In this phase, we are evaluating the design of the toys, the accordion and the balloon.

Participants and methodology

Four children ages 4-8 played with our initial prototypes. Two evaluation sessions were conducted (one at a research lab setting and one at one of the children's homes). For both evaluations the investigator introduced the toys to the children by providing a brief demonstration of the toy. After the demonstration the toy was turned over to the children. The children were free to play with the toy as long as they wanted. After the children stopped playing with the toy the investigator asked them questions about the experience. The children's interactions with the toy were video recorded.

Results and Future Work

Children experimented with the recording and playing of their own recordings with both the accordion and the balloon. The physicality of the toys invited sharing and co-creation among the children (e.g., making funny sounds and commenting "… sounds like a spaceship about to rise." They also recorded their dances and songs). More focused recording was observed with the balloon than the accordion (perhaps due to the simpler two handed manipulation). On the other hand, the accordion was used more as a sound controller.

Children's work with the toys suggests that children have trouble understanding mode changes between record and playback, and in understanding that the toys are remote controllers for the video content that was displayed on screen. We are working to redesign the toys to physically represent mode changes, i.e. by physically opening during record mode, and closing during playback. We are also considering ways to pursue coinciding input and output to avoid the notion of the toys as remote controllers. Furthermore, we are refining the digital signal processing to be faster, smoother and more akin to physical and analog media.

Children's reactions to the window have suggested that smaller and more directly manipulable videos will be more intuitive for children. We are extending the interactions with the window to be more similar to our original designs, where the window is a palette for collecting and sharing of the movies, or "message bubbles." We intend to design a furniture-like housing for the window, i.e. as a shared table, and to add touch screen functionality to the window. A touch UI will allow children to share their media and performances with remote family and friends by moving images of their performances on top of icons of friends and family who live at the edges of the window. Future evaluations will address children's interpretations of the system's communications functions.

Conclusion

We presented our ongoing effort to create a set of tangible communication tools for young children that celebrate their ability to create multi-modal expressions and make creative use of their recorded expressions physically. Initial results informed us with ways to leverage the physical properties of the toys and support playful exploration of children's recorded video messages for sharing. We are continuing to develop our system, improving the design of the physical toys and the window to support both synchronous and asynchronous exchanges, so that the process of children's multi-modal creations and sharing their creations with remote partners can be supported in a playful way.

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References

[1] Ananny, M. & Cassell, J. Telling Tales: A new toy for encouraging written literacy through oral storytelling. Society for Research in Child Development Conference, Minneapolis, USA. April 18-21, 2001.

[2] Dobson, K. ScreamBody (1998) http://web.media.mit.edu/~monster/screambody/

[3] Gardner, H. (1983). Frames of mind: The theory of multiple intelligences. New York: Basic Books.

[4] Ishii, H. and Ullmer, B., Tangible Bits: Towards Seamless Interfaces between People, Bits and Atoms, in *Proceedings of CHI '97*, ACM Press, pp. 234-241

[5] Kay, Alan. A Personal Computer for Children of All Ages. Proceedings of ACM National Conference: ACM Press. Boston. August, 1972.

[6] Ryokai, K., Marti, S., Ishii, H. (2004) I/O Brush: Drawing with Everyday Objects as Ink, in Proceedings of Conference on Human Factors in Computing Systems (CHI '04).

[7] Shneiderman, B., Direct Manipulation: A Step Beyond Programming Languages. IEEE Computer, vol. 16, 1983, 57-69.

[8] Zigelbaum, J., Kumpf, A., Vazquez, A., and Ishii, H. Slurp: tangibility spatiality and an eyedropper. In CHI '08 Extended Abstracts (2008).