reMi: Translating Ambient Sounds of Moment into Tangible and Shareable Memories through Animated Paper

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Figure 1: Prototype of a tangible memory notebook, reMi, has non-machine-like interface. It contains shape-changiable papers which replay the recorded sounds and animate its shape synchronized with the sounds.

ABSTRACT

We present a tangible memory notebook–reMi–that records the ambient sounds and translates them into a tangible and shareable memory using animated paper. The paper replays the recorded sounds and deforms its shape to generate synchronized motions with the sounds. Computer-mediated communication interfaces have allowed us to share, record and recall memories easily through visual records. However, those digital visual-cues that are trapped behind the device's 2D screen are not the only means to recall a memory we experienced with more than the sense of vision. To develop a new way to store, recall and share a memory, we investigate how tangible motion of a paper that represents sound can enhance the "reminiscence".

Author Keywords

Tangible Memory; Shape-changing Paper; Reminisce

CCS Concepts

•Human-centered computing → Sound-based input / output; Interface design prototyping; *Displays and imagers*;

INTRODUCTION

"The next best thing to the enjoyment of a good time, is the recollection of it" (James Lendall Basford.)

Recalling the past moment helps people to create and maintain their relationship, and sharing memories with others enhances

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ACM ISBN 978-1-4503-5949-8/18/10. https://doi.org/10.1145/3266037.3266109 storytelling [10]. Digital devices have improved the way to capture a moment by collecting digital photos and videos, however, those visual-cues behind the 2D screen are not enough to evocate a memory and they are incomparable to a physical artifact which allow us to interact with using various senses of body [2, 9]. To explore a new way to record and recall a memory, researchers in HCI community have been focusing on a different form of physical artifacts [10]. Bennett et al. [1] designed tangible tiles to support storytelling, and reminiscence. Nostalgia [6] used a textile artifact to evoke the memory for elders. Recently the potential of sound as a memory-cue for reminiscing has been shown. Dib et al. [3] and Petrelli et al.[8] showed that sound is more evocative and personal memorycue than photos. Frohlich et al. [4] showed that storing audio data with one's physical object has a benefit of attaching stories to souvenirs. It is proven that natural and ambient sounds are the most preferred auditory-cue for people to record [7, 5]. In this project, we used the sounds to capture the moment and translated them into a tangible motions of paper. By doing so, we investigate how tangible motion can bring to life the sound to enhance the "reminiscence". To integrate tangible interactions with sound in a seamless way, we developed a portable tangible memory notebook, reMi. We mapped the sounds to the different motions of papers. Also, we introduce a fabrication process of paper circuits and actuators in a pocketsized notebook form. Use-case scenarios for reMi highlight its potential applications. The working prototype of reMi can be found in a video (https://youtu.be/ZZ-T7m3fpPA).

DESIGN OF reMi

Before the digital age, pocket journals were the most common means of jotting down personal memories to then be saved as a diary entry or shared with others. Inspired by this natural behavior, we focused on affordances of notebooks. Each page serves as a container of moments. We made a pocket-sized

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Poster Session

notebook that does not have any digital graphic user interface component. reMi has two affordances of interactions: folding and ripping a paper. The folding triggers the microphone to record sounds and have them stored on a paper. As we bookmark a book such as dog-earing the corner of a page, users fold a page of reMi to bookmark a precious moment. Similar to how classmates rip out notes and fold it to pass around the classroom to communicate with friends, ripping the page allows users to share their memories. We designed a wood binder clipper (Fig. 2f) which not only allows users to decorate rooms with memories but also functions as a power connector with less machine-like design.

IMPLEMENTATION

Inside of the back cover of reMi, microcontroller (MCU) (Teensy 3.2), microphone with amplifier (MAX9814), lithium ion polymer battery (3.7v 2500mAh), power converter and charger (Adafruit PowerBoost 1000) were integrated. Each page's back side has a control circuit and a speaker (Fig. 2d, c) made of a copper tape cut by a vinyl cutter. When users dog-ear the top corner of the page, the copper tapes on the corner make a contact which connects the control circuit to the battery. Once the circuit is on, the microphone starts to record the ambient sound. Copper binding rings (Fig. 2e), which are electrically isolated each other, connect each page to the MCU. We used polypropylene sheets to make the pages and engraved different crease patterns on them using a laser cutter. To obtain a larger deformation of a shape-changing paper, we customized a shape-memory alloy (SMA) fiber (BioMetal BMF 150) to have a coil structure which increases the maximum strain rate. Unfolding the corner of page terminates the sound recording. Fast Fourier Transform of the recorded sound is executed to map the frequency of the sound to the duty cycle of Pulse Width Modulation and the amplitude to the driving current of the SMA actuation. The control circuit of the detached page has to be plugged in an external power (3-5V) to actuate the paper motions with replaying the recorded sound. We used a wood binder clip (Fig. 2f) as a power connector.



Figure 2: Hardware system diagram of the reMi. (a) Dog-ear bookmark copper tapes. (b) SMA arrays to actuate the paper motion. (c) Paper speaker. (d) Control circuit for SMA and sound play. (e) Copper binding rings (f) Wood binder clipper as a power connector.

USE-CASE SCENARIOS

Memory Display: People take souvenirs such as postcards, and pin these keepsakes to their walls and prop them on their desks. reMi functions in a similar. For example, we are traveling to a tropical beach, instead of purchasing a generic souvenir to bring home, with reMi, we are able to record the ambient sound of the waves. After the trip, we rip off some pages of the reMi to display them on a wall to decorate our room with these archived moments. Not only can we listen again to the sounds of the waves we recorded but also, we can touch the motion of paper representing the wave sound of that moment.

Card: We write cards to send greetings and share memories. Users can write notes or draw on reMi's pages which enables them to create a new story on top of the recorded memory. For example, parents trip to the Yosemite National Park, the sound of water fall reminds of the past Christmas when they went there with their son. They record the sound on a wavy patterned page of reMi to send this moment to their son as a Christmas card. While recording the sound, they write their greetings on the page. When their son receives the card and plays it, the card starts to move as like waving in the water fall of the Yosemite, which reminds him of his young age when he was soaking his hands near the water fall.

Wrapping a Physical Memento: Pages of reMi enable users to add another layer of story to a physical artifact by wrapping it that are reminiscent of memories. For example, John found a small toy that he used to play with his sister in the backyard. He wanted to give this toy to her to remind her of the past playful moment. He recorded the ambient sound of the backyard in the reMi and ripped off the page. He used the page to wrap the toy. The gift itself becomes another physical memento from the past covered with new story of the present.

Shared Keepsake Scrapbook: The reMi can be also used for a shared scrapbook of memories. For example, John and Jane have kept their reMi with them to record their moments together since John proposed to her. When they have a baby girl, Marry, the whole notebook itself becomes a storytelling book summarizing all the history of her parents. Marry finds a page that has a moment when her mother found out about her pregnancy. The page renders a sound of womb with tiny wriggly motions of the paper and she builds more attachment to her parents.

CONCLUSION

We introduced a tangible memory book–reMi–which records the ambient sound of moment and recalls it by shape-changing paper's motions with replaying the recorded sound. We showed the system implementation that enabled us to integrate the paper electronics and actuator in a pocket-size notebook. With the highlighted use-case scenarios, we imagine to see people are bringing the reMi in any circumstances, to capture the precious moment in more personal, share it with others, and create new stories through the process of recalling the memory in a tangible space.

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