Memory Bottle

Juliana Covarrubias*
Department of Mechanical Engineering
University of California, Berkeley
Berkeley, California, USA
julicov@berkeley.edu

Chetan Goenka*
Department of Electrical Engineering &
Computer Sciences
University of California, Berkeley
Berkeley, California, USA
cgoenka@berkeley.edu

Jannes Feldmann*
Department of Engineering & Computer
Science
University of Applied Sciences
Osnabrück, Germany
jannesfeldmann@berkeley.edu

Stephanie Tondow*
School of Information
University of California, Berkeley
Berkeley, California, USA
stondow@ischool.berkeley.edu

W. Carter Valle*
College of Letters and Science
University of California, Berkeley
Berkeley, California, USA
williamvalle@berkeley.edu

Think back to a moment in the last year—what do you remember? Did a photo or video capture that feeling? *Memory Bottle* is a tangible user interface (TUI) that bridges the gap between how we document moments and how we experience them. This ephemeral recording device encourages the formation of a grounding habit through an alternative method of documentation: focusing on collecting small yet meaningful sensory elements throughout the day and reviewing them once before letting them go.

The device takes the form of a bottle that captures specific sensory inputs: color, temperature, and audio. *Memory Bottle* is paired with an external device, the *Sensory Station*, which transfers sensory data collected throughout the day into an abstracted output that users engage with to intentionally process their experiences. This TUI centers memory, attention, and ritual to transform memory-making into an actively mindful experience.

CCS CONCEPTS • Affective Computing • Ambient Display • Tangible Interfaces • Visual Interface Design

Additional Keywords and Phrases: Affective Computing, Ambient Display, Internet of Things, Memory, Attention, Technology for Reflection

_____

*Equal contribution.

1

1. INTRODUCTION

In our information-saturated world, we are battered with constant stimuli that have negatively affected our ability to focus, be present, and make memories [1]. Humans have a natural urge to document the world as a way to make sense of our lives, share our experiences with others, and remember specific moments [2] through artifacts such as photographs and videos. Today, this documentation is muddled into cluttered digital archives, where our devices are filled with media we will hardly ever revisit—blurry concert photos, screenshots from TikToks, or accidental pocket recordings.

Furthermore, because modern recording devices can capture and store details in high fidelity, people increasingly rely on their devices to retain memories. This reliance can lead to poor recall and consolidation of experiences [3]. Through the abundance of highly detailed documentation, we risk losing appreciation for—and attention to—the act of memory-making itself.

RQ: How might we design a device to help people experience and remember a moment more intentionally? We seek to create a multi-sensory recording device that encourages users to process and release recordings rather than hoard them. We hypothesize that this capture-and-release interaction will foster more intentional engagement with moments, contributing to the creation of meaningful memories. Rather than capturing perfect one-to-one recordings, our device isolates individual sensory elements that more effectively represent the feeling of a moment. Through this alternative process, we aim to establish a mindful ritual of recollection.

2. CONCEPT

2.1 Background

The influx of overly accessible information has altered how people interact with and perceive the world, contributing to divided attention and weakened memory formation. Cognitive research shows that divided attention weakens both verbatim memory (specific details) and gist memory (the general sense of an experience) [4]. When documenting moments through photographs or videos, people often engage in cognitive offloading [5], storing memories externally rather than internally. High-fidelity capture can reduce the perceived need to encode experiences personally. When attention is scattered, memories are fragmented—leaving records without the nuances that made moments meaningful.

2.2 Research and Related Works

Prior Human-Computer Interaction (HCI) projects from the MIT Tangible Media Group have explored ambience and awareness, including *ambientROOM* [6] and *musicBottles* [7]. These works explore how digital information can be felt through subtle sensory cues such as light, sound, and movement. Artist Jim Campbell's abstracted aesthetic further inspired the low-fidelity, atmospheric output of our project [8]. Another related project is *The Bouquet* [9], a student project led by Niklas Roy through ECAL's Bachelor of Media & Interaction Design program. This TUI project allows users to perceive color through fragrances. Together, these influences informed the team's focus on sensory communication and the concept of capture and release—designing a device that conveys the *feeling* of a moment rather than a literal representation.

Memory Bottle builds on these projects by incorporating dynamic recording and synchronized playback. At its core, it is an Internet of Things project. Input is ethnographic and multi-sited rather than isolated within a controlled environment or with set stimuli. Additionally, the recordings are impermanent

after playback in the Sensory Station. It is not about revisiting a memory, a site, a scent, or a musical input in perpetuity but the act of release.

2.3 Our Project

Memory Bottle is a bottle-shaped recording device designed to capture distinct aspects of a user's day—color, audio, and temperature. It encourages users to seek out overlooked sensory stimuli that contribute to meaningful experiences. Interaction begins when a user identifies a moment they wish to record and opens the bottle's cap. The selected sensor records until the cap is closed. After collecting data throughout the day, the user brings the bottle to the *Sensory Station*. When the bottle is uncapped and tilted in a pouring motion over the station, the collected data is transferred and compiled into an ambient display of light and sound. Users engage with this display in a ritual of reflection, observing abstracted sensory impressions of their day.

2.4 Sensory Ritual

Grounding techniques often encourage engaging multiple senses to connect to the present moment. Building on these practices, *Memory Bottle* explores how tangible interaction can support memory-making through ritual. Intentionally low-fidelity, the system invites users to pause, attend, and reflect. The bottle serves as both a capture tool and a symbolic container for experiences, while the release phase provides an ephemeral, multisensory reflection. Together, these interactions counter the fast-paced, permanent, and perfection-oriented tendencies of contemporary documentation culture.

3. DESIGN & INTERACTION

The system consists of two components: a portable bottle for recording and a stationary *Sensory Station* for replay. The bottle is designed as an everyday object that accompanies users throughout their day, mirroring the temporary nature of short-term memory. The Sensory Station, situated in the home, acts as a microspace for reflection and release.

3.1 Input: Capture

The recording device is a custom 3D-printed bottle that captures three sensory inputs—color, temperature, and audio. Users select the sensor by rotating the bottle's base. While recording, an LED indicates the collection process. The bottle houses an Arduino Nano connected to a color sensor, thermometer, and microphone, storing data on a micro SD card. Bluetooth enables the data transfer to the Sensory Station. This act of intentional capture encourages daily mindfulness and attention to sensory detail.
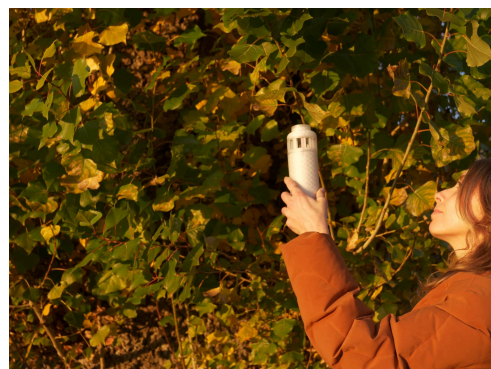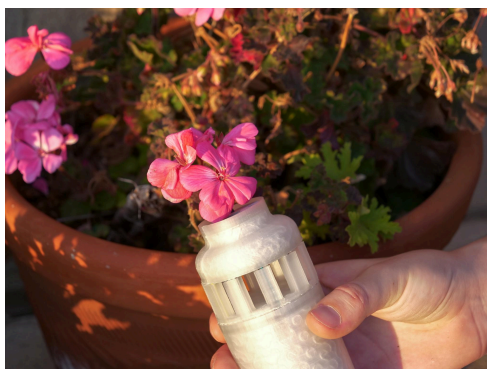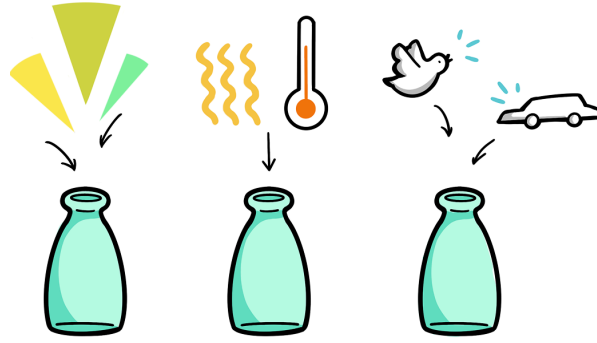
Figure 1: From top, collecting color and audio outside.
An illustration of the capture process (from left to right): color, temperature, and audio.

3.2 Output: Release

The release phase occurs at the Sensory Station, a box that emits ambient light and sound. When the bottle is uncapped and tilted, an onboard tilt sensor activates Bluetooth data transfer. Playback unfolds slowly, emphasizing abstraction and reflection rather than accuracy. Similar to a Polaroid image developing over time, impressions gradually cohere into a reflective experience. After a set duration, playback fades, and the bottle's contents are erased for reuse.

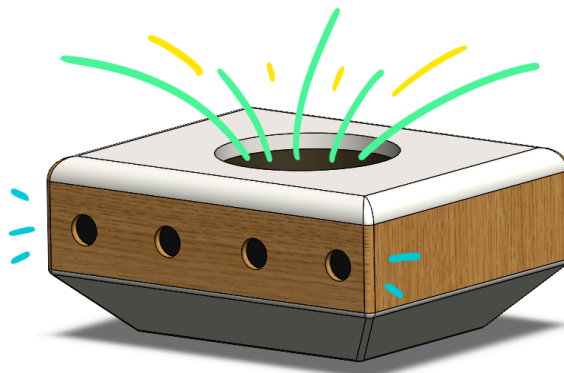*Figure 2: Releasing captured moments and watching them fade away.*

Figure 3: Preliminary design of the Sensory Station with internal light and side-mounted speakers.

4. TECHNICAL IMPLEMENTATION

4.1 Overview:

Memory Bottle consists of two interconnected components: a handheld recording device that allows the user to record specific sensory information and the *Sensory Station*, which is used for playback and release. We have implemented a working prototype that allows for one color sample recording and a 15-second ambient audio recording. The recordings are housed locally inside the *Memory Bottle*, which is later transferred wirelessly through Bluetooth to be output to the *Sensory Station*, where it is replayed in an abstracted ambient form.

4.2 Memory Bottle Prototype, Interaction:

A button is positioned at the top of the bottle's spout. When the cap is closed, the button is pressed down, and when opened, it is released, initiating the recording session. A ring of LED lights, mounted upside-down at the top of the bottle and powered through a cable to a wall outlet, provides visual feedback on the bottle's status. As the bottle records either color or audio, the LEDs gradually illuminate, creating the impression that the bottle is slowly filling up. A potentiometer is embedded in the base, allowing the user to interact with the bottle by swiveling it back and forth to select the recording type. When untouched, the bottle remains idle and the LEDs are off, but depending on the direction of the swivel, the LEDs light up red to indicate readiness to record color or blue to indicate readiness to record audio. Once the bottle has captured both types of recordings, it lights up green, signaling that it is full and ready to be poured out over the Sensory Station.

4.3 Memory Bottle Prototype, Input Sensors:

Our Memory Bottle prototype is a custom 3D-printed enclosure that is controlled using an Arduino Nano. The primary sensors include a color sensor, which captures a single dominant color value, and a microphone, capable of recording up to fifteen seconds of audio. Both sensors are housed at the top of the bottle and threaded through channels in the pillars framing the bottle's windows, ensuring stable placement and quality recordings. These sensors are connected directly to the Arduino Nano for processing. A set of additional sensors are embedded in the bottle to ensure functionality and interaction. The base of the bottle includes a tilt sensor, which allows the Arduino Nano to detect whether the bottle is upright or upside-down. This functionality enables a pouring interaction, triggering the wireless transfer of recorded data to the Sensory Station for output. Together with the potentiometer and LED ring, these sensors help guide the user's interactions and provide real-time feedback.

4.4 Memory Bottle Physical Design:

At the base of the bottle, we encoded a playful interaction for selecting the type of recording. The base is connected to a potentiometer, mounted upside-down on the bottle shaft, allowing users to smoothly swivel the bottle to choose between color or audio recording. The shaft functions as an open compartment housing the tilt sensor and Arduino Nano, along with the soldered jumper wires that connect all electronic components. A series of windows extends along the shaft toward the bottle's spout, guiding user hand placement while also providing channels for routing sensor connections. Although these windows were initially intended for an LED display, the LEDs were repositioned lower on the shaft to support more efficient connections. The hollow pillars framing the windows allow the spout-mounted sensors to connect internally, maintaining a clean layout while creating the impression of wireless connectivity. The

gentle curvature of the shaft and placement of the windows subtly suggest how the bottle should be held and interacted with, reinforcing cohesion between the bottle's physical form and its interactive behavior.

Figure 4: Memory Bottle: Working Prototype Design

4.5 Sensory Station Output, Prototype:

The output of the Memory Bottle is experienced through the Sensory Station, where the recorded color and audio fuse together into an ephemeral ambient experience. After the bottle is tilted using a pouring motion, that signals the stored data to be wirelessly transmitted to the station. The Sensory Station houses a ring of LED lights mounted around a circular cutout at the center of the base, oriented downward and shining into the bottom of a bowl that reflects and diffuses the light back toward the user. The LEDs are programmed to receive the color values captured by the bottle's color sensor and translate them into a soft, pulsing light display. The station is powered by an Arduino Uno R4, which controls the LEDs and is connected to a laptop that hosts the code for both the Memory Bottle and the output system. A Bluetooth speaker housed within the enclosure and connected to the laptop outputs the recorded audio during playback.
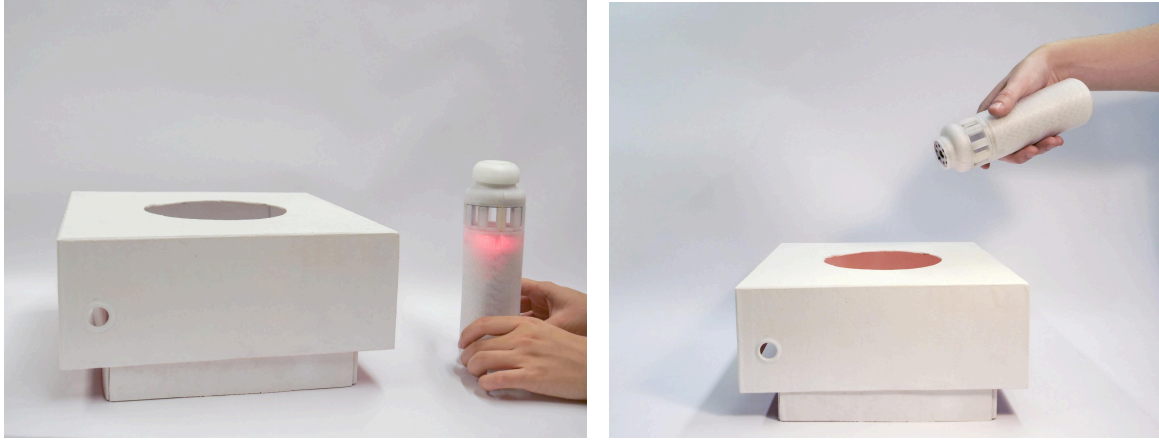
Figure 5: Input-Output Interaction (from left to right)

4.6 Use Case

Memory Bottle is designed for individuals seeking greater presence in daily life. Through repetition and ritual, users may develop habits of mindful attention to small details often overlooked due to divided focus. The act of replay encourages emotional release and grounding, offering something more affective and embodied than conventional photo documentation.

5. EVALUATION

Memory Bottle was piloted at the University of California, Berkeley, School of Information event with a total of 30 participants. The demonstration included five colorful objects, the bottle, the Sensory Station, and an infographic illustrating the user interactions for the input.

5.1. Preliminary Findings

All participants were eager to engage with the bottle but needed instruction on how to interact with it. The infographic helped most understand how to record input, but in general, participants needed step-by-step explanations or preliminary demonstrations of the core interactions. Given the intimate interactions, each participant engaged one at a time. Small groups crowded around, watching and waiting for their turn.
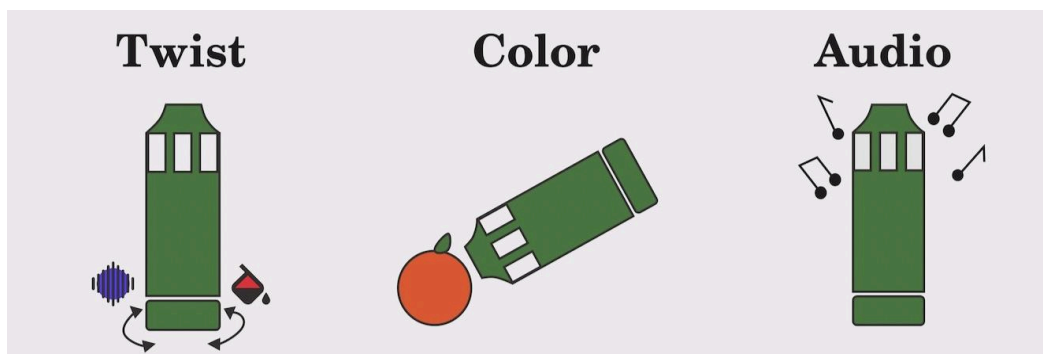

Figure 6: The infographic describes the input interaction for recording color or audio.

5.2. Individual interactions

Participants were naturally drawn to record color from the displayed objects, but not how to switch between senses with the potentiometer. Pressing the button between each sense recording did not seem like a natural interaction. One person asked, "Should I say something?" before bending down and whispering a memory into the microphone. There was hesitancy about what to say in the audio recording, and most did not fill the 15-second limit. Participants responded well to the feedback from the LEDs in the bottle as audio and color were recorded, with one person saying, "I can see it filling up; that's cool." One-third of the participants attempted to record multiple colors.

All participants responded with surprise and awe when the audio-visual stimuli was played back at the output station. "It's ready now? Wow, that's really cool," said one participant in response to the output. One participant asked how color-blind participants might interact with the bottle, prompting the team to consider recording other senses.
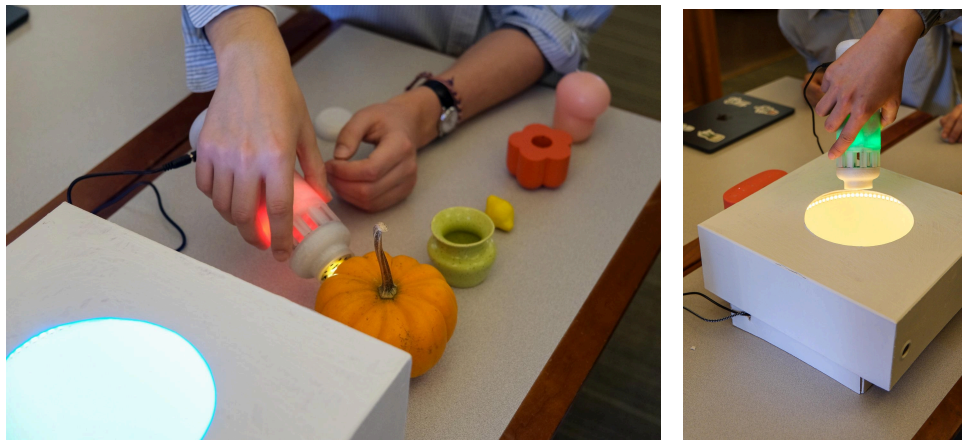

*Figure 7: Users testing input and output interaction at the 2026
Tangible User Interface Showcase. Photos by Emily Liu.*

6. FUTURE WORK

For future iterations of the Memory Bottle, we want to explore a number of different iterations. Focusing on hardware, the current prototype was intentionally simplified to meet project deadlines and ensure core functionality. Moving forward, we are interested in incorporating a temperature sensor that could capture ambient temperature values and map them to the output, either by shifting the color palette toward warmer or cooler tones or by introducing a temperature-based output, such as emitting warm or cool air. In addition, we aim for future versions to reduce reliance on an external laptop and cord-related power supplies. A core theme of the project is portability and the ability to carry the bottle anywhere; transitioning to battery power and onboard processing would better support this intention. Finally, expanding the system to support multiple stored memories and audio recordings would significantly enhance interactivity and allow for more complex and layered output experiences at the Sensory Station.

7. CONCLUSION

The ease and volume of modern photo and video capture have transformed recording into an automatic reflex rather than a mindful act of preservation. *Memory Bottle* offers an alternative approach, encouraging users to slow down, attend to sensory experiences, and reflect intentionally. By emphasizing

abstraction, ritual, and release, the system supports deeper engagement with lived experience and memory-making.

ACKNOWLEDGMENTS

REFERENCES

[1] Obada Al-Leimon, Wei Pan, Abdul-Raheem Jaber, Ahmad Al-Leimon, Abdel Rahman Jaber, Mohammad Aljahalin, and Latefa Ali Dardas. 2025. *Reels to Remembrance: Attention Partially Mediates the Relationship Between Short-Form Video Addiction and Memory Function Among Youth*. Healthcare (Basel) 13, 3 (January 2025), Article 252. https://doi.org/10.3390/healthcare13030252

[2] Deanna Dent. 2018. *Why are humans so obsessed with self-documenting?* ASU News. Retrieved from https://news.asu.edu/20180608-creativity-cell-phone-photos-art-self-documenting

[3] Rebecca Lurie, Sophia P. Fabrizio, and Deanne L. Westerman. 2025. The cost of saving: How photos and screenshots impair memory. Memory & Cognition 53, 7 (October 2025), 2301–2311. https://doi.org/10.3758/s13421-025-01711-2

[4] Benjamin C. Storm and Sean M. Stone. 2015. Saving-enhanced memory: The benefits of saving on the learning and remembering of new information. Psychological Science 26, 2 (February 2015), 182–188. https://doi.org/10.1177/0956797614559285

[5] Hiroshi Ishii, Craig Wisneski, Scott Brave, Andrew Dahley, Matt Gorbet, Brygg Ullmer, and Paul Yarin. 1998. *ambientROOM: Integrating ambient media with architectural space*. In CHI '98 Conference Summary on Human Factors in Computing Systems. ACM, New York, NY, USA, 173–174.

[6] Hiroshi Ishii, Ali Mazalek, and Jay Lee. 2001. Bottles as a minimal interface to access digital information. In CHI '01 Extended Abstracts on Human Factors in Computing Systems. ACM, Seattle, WA, USA, 187–188.

[7] Jim Campbell. 2025. *JimCampbell.tv*. Retrieved November 20, 2025 from https://www.jimcampbell.tv

[8] Katherine W. Song, Janaki Vivrekar, Lynn Yeom, Eric Paulos, and Niloufar Salehi. 2021. Crank That Feed: A physical intervention for active Twitter users. In Extended Abstracts of the 2021 CHI Conference on Human Factors in Computing Systems (CHI EA '21). Association for Computing Machinery, New York, NY, USA, Article 433, 1–6. https://doi.org/10.1145/3411763.3451817

[9] Bouquet: Synaesthetic Olfactory Device to Perceive Color Through Fragrance. 2016. CreativeApplications.Net. Retrieved December 2025 from https://www.creativeapplications.net/project/bouquet-synaesthetic-olfactory-device-to-perceive-color-through-fragrance/