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<https://doi.org/10.1145/3322276.3322362>

PUBLISHER

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AM (Accepted Manuscript)

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REPOSITORY RECORD

Kim, Kyung Jin, Sangsu Jang, Bomin Kim, Hyosun Kwon, and Young-Woo Park. 2019. "Muredder: Shredding Speaker for Ephemeral Musical Experience". figshare. <https://hdl.handle.net/2134/37561>.

muRedder: Shredding Speaker for Ephemeral Musical Experience

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Figure 1. Final design of muRedder. A user (a) browsing a collection of songs from a ticket book, (b) inserts a song ticket in muRedder (c) and the ticket is being shredded while muRedder plays a song. (d) Remnants of tickets are piled up in the muRedder visualizing the number of songs has been played.

ABSTRACT

The experience of sound may be seen as fleeting or ephemeral, as it naturally disperses through space in waveforms unless recorded by media. We designed muRedder to reinstate the ephemerality of sound by shredding a song ticket that embeds a sound source while playing the song simultaneously. In this study, we explored ordinary music listening activities by turning intangible music content into tangible artefacts, making the music unable to be replayed, and representing the sound-fading process by shredding the ticket. We conducted a field study with 10 participants over seven days. The results showed that muRedder enabled users to focus solely on the music content and to actively find times to enjoy the music. We also found that limitedness of the media draws prudent decision in selecting music. By showing the process of consuming the invisible auditory content in a way that is tangibly perceivable, our findings imply new value for slow consumption of digital content and musical participation in public spaces.

Author Keywords

Ephemeral interface; music; physicality; materialization

CSS Concepts

- Human-centered computing ~ User interface design

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DIS '19, June 23–28, 2019, San Diego, CA, USA
© 2019 Association for Computing Machinery.
ACM ISBN 978-1-4503-5850-7/19/06...\$15.00
<https://doi.org/10.1145/3322276.3322362>

INTRODUCTION

Digital music-streaming services have freed people from location and time constraints when enjoying music by allowing frequent access to music and repeated listening [3, 15, 30]. At the same time, tangible media such as CDs and LPs are still used to listen to music; in 2017, sales reached 14 million in the United States. In 2018, there was a 19.2% increase in sales [31]. In addition, live music concerts, festivals, and gigs are beloved in culture, albeit opportunities for these experiences are somewhat limited [22]. This phenomenon is due to the experience given by context-based transient music provision [18, 29] and the physical richness of tangible music albums. The conventional analog media offer much experiential value in music consumption that may not be obtained through digital music [22]. In other words, assigning music to a tangible medium and the opportunity to play the music within its physical constraint enables people to consider the times and situations in which they consume music. This valuable analog music listening experience merits consideration within the current scenario that is punctuated by the coexistence of digital music streaming services and the revival of vinyl records. In response to such issues, we could confirm the necessity of providing material presence [16] to invisible digital music content and turn the listening experience into a momentary event that more closely approximates context-specific temporal experiences [14, 23, 32]. We approached this endeavor by rematerializing digitized songs and applying ephemerality in its consumption through the physical limitations to its reusability.

In this regard, a variety of cases have been studied that involve human-computer interaction, which creates value by placing functional limitations [6, 15, 21] on digital products.

These cases include cement cameras [20], social clocks, radios, and sound boxes [13], which applied counterfunctionality [19] in their expected usages. However, in these studies, providing value through applying limited interactions, such as ephemerality, to the music-consuming experience has rarely been studied. In addition, some cases have considered ephemeral interactions with digital content to provide attentive experiences [5, 12]. Those cases have mapped digital content into each medium, and the forms can be easily changed because they are fragile and disposable, such as bubbles [12, 25], smoke [1, 25], and candles [28]. These studies showed the ephemeral characteristics of single-use materials in addition to projection technologies. Regarding the study of giving materiality to digital content, a design approach was introduced to resolve the dematerialization phenomenon by providing a rich interactive experience in selecting and listening to music files [29].

Building on the extensive body of work, we found a design space in the everyday music-consuming experience. Thus, the aim of this study was to provide the limitedness of the live experience in music consumption by tangibly applying ephemerality to the music content. For this, we designed paper tickets to embed music files and a speaker that played music while shredding a ticket. We conducted a field study to examine how muRedder was used in everyday life and how people engage in musical experiences it.

MUREDDER DESIGN AND IMPLEMENTATION

MP3 music files, streaming service platforms, and digital devices have accelerated the transformation of musical experience becoming mobile and ubiquitous. This has allowed us to enjoy music with very little cost and effort in various situations. Music or audio often sits in our periphery unless we purposefully attend live concerts or shows. We designed muRedder to understand how people consider places and contexts when listening to music streams that have been offered with limited availability. Sound is naturally ephemeral; thus, we attempted to transform digital music into a transient media that offers a live experience in our everyday living environment. In so doing, we designed a novel speaker that disables “replay” by destroying a song-embedded paper ticket once it has been used. Moreover, we wanted to allow users to see the consumption process directly by aligning the duration of a song with the time it takes to shred the paper ticket. Knowing that the music can be played only once, we envisaged our design would bring a mindful and immersed music-consuming experience, from selection to listening and reflection. Moreover, we expected that a strong emotional attachment would emerge during and after the experience [24]. In what follows, we will describe the details of muRedder, which consists of song tickets and a shredding speaker.

Song Ticket and Ticket Book

In designing muRedder, we also aimed to capture the enjoyment that people have with tangible music albums [33], which are now mostly retired due to digital music-streaming

services. In accordance with this, we reassigned digital music onto a physical medium. HCI researchers have previously explored several ways to apply tangibility to music such as assigning plastic or metal tokens to create or perform musical rhythms or songs [26]. In addition, paper cards were used to represent tangible songs in online music stores [7]. Paper was used to take advantage of its applicability as a visualization, distribution, and retrieval medium. In this regard, we also selected paper for the ticket design as it is inexpensive, varies in type, and is easy to produce and customize. Our design of the song ticket (Figure 2a) was inspired by a CD with an album cover. Each song ticket is disk shaped (55 mm diameter). Information about the song (e.g., title and artist) is printed on the front of the ticket and a very thin RFID sticker tag is attached on the back of the ticket, which is shredded with the paper ticket. We also designed a ticket book (Figure 2b) with an intention to see how users managed their playlists and explicitly handled their music collections by aligning, prioritizing, consuming, or saving for later.

Figure 2. (a) Paper song ticket and (b) ticket book.

Shredding Speaker

Among many other materials (e.g., fog or soap bubbles) and methods (e.g., dissolvent) to achieve ephemerality, we selected a shredding mechanism to allow the paper song ticket to be used only once and to tangibly visualize the shredded remains. In addition, shredding is a familiar method to make the paper document irreversible, so we expected that this approach would help users to understand that the song ticket cannot be reused. To implement a robust digital device by embedding the shredding structure that can be situated in our everyday environments [17], we designed muRedder’s main body (i.e., the shredding speaker) into two parts. The upper part (Figure 3a) includes all the electronic parts needed for detecting and shredding the ticket. The bottom part (Figure 3b) is storage that keeps the shredded ticket strips. When the ticket is inserted into the speaker-hole cover, it rolls through the passage gap. Then the ticket reaches a customized PCB that consists of Arduino along with an RFID reader and an MP3 module. For the study purpose, we used a micro SD card that readily stored songs distributed by in the ticket. Once the ticket reaches this part of the device, the speaker recognizes the song and starts to play the music

while the ticket is simultaneously shredded. The shredder module cuts the falling ticket into slices using two gears connected to a 6V DC motor. We devised the shredding speed to be in accordance with the length of the song to show how much of the music was consumed by the amount of shredded tickets produced. Lastly, the upper and bottom parts are affixed by magnets, which allow users to easily separate them.

Figure 3. The structure of shredding speaker.

Use of muRedder

The basic way of using the final design of muRedder can be described as follows. First, the user selects a song ticket among several tickets in the ticket book (Figure 1a). When the user inserts a paper ticket into muRedder (Figure 1b), it plays a music track embedded in the ticket while shredding it simultaneously. Through the translucent acrylic container, the user can see the shredding process. While the music is playing (Figure 1c), another song ticket cannot be played and shredded until the inserted song reaches the end. After the song is finished, the traces of the ticket are stored at the bottom part of muRedder (Figure 1d). Users can also separate the upper part of muRedder and periodically empty the shredded tickets stored in the bottom part.

FIELD STUDY

We conducted a series of field studies [2] with muRedder to explore the experiential value of tangible engagement with an ephemeral medium – music – in everyday settings.

Participants

We recruited participants by posting an advert on our Facebook page for a couple of weeks. We asked applicants to describe their music consuming habits. We selected 10 participants who had a clear preference for music, so they actively searched, listened to, and used online streaming services more than an hour every day. Table 1 shows each of the 10 participants' ages, household type, favorite genre and favorite artists. All participants applied independently. Three lived alone, four lived in shared houses, and three lived with family. None of the participants lived in the same house.

ID	Age	Household type	Favorite music genre	Favorite artists
P1	24	Individual	Pop, Rock, Indie	Troye Sivan
P2	26	Individual	Indie, Ballad	Maroon 5, Park Hyoshin

P3	24	Share house	R&B/Soul, Hip-hop	Heize, Crush
P4	24	Share house	Ballad, Rock, Dance	Yoon Jongshin, Yoon Band
P5	24	Share house	Indie	Zingo, Blackskirt
P6	27	Individual	Pop, Ballad	40, Naul,
P7	23	Family	Hip-hop	Bet Sa Gong
P8	24	Family	Ballad, Jazz, Rock	MeloMance
P9	24	Share house	Ballad, Indie	IU, Jung Seunghwan
P10	26	Family	Hip-hop, Pop, Indie	Epik High, BOL4

Table 1. Age, household types, favorite music genre and favorite artists of each study participant

Deployment and Data Collection

A day before the installation, we contacted the participants to ask them about their (a) favorite and frequently played songs and (b) favorite artists (Table 1). We prepared nine different songs based on each participant's music preference. Only 9 songs were provided to allow users to view all titles at a glance when they unfold their ticket book. We also sought to deeply investigate the experiential value of tangible engagement with ephemeral song tickets through offering a limited number of tickets. Three songs were from the participants' most frequently played songs. This list was designed to see how people experience familiar music content from different media knowing that it cannot be replayed. Another three tickets were from their favorite artists' live music records to represent the sense of limitedness. The last three songs were selected from artists who are less well known to the general public that participants would not have come across before or recommended songs based on participants' favorite music genres. During the Day 1 interview, again we asked about the familiarity of the songs that we provided to the participants. There were some (N=2) who remembered that s/he had listened to the songs once or twice before, and others said those were new songs that they had not listened to before.

We deployed muRedder in each participant's home for seven days. As music has two functions, listening alone and sharing, we selected the home as a use context because it can provide a space in which to listen to favorite songs privately and so that users could engage in sharing experiences with other members of the household. On the first day of the user study, we visited the participants' homes to install the device (Figure 4), gave a brief introduction regarding the study, and interviewed them about their general music consuming habits. We also demonstrated muRedder with one ticket of their choice. We ensured that there was no obligation in the number of tickets they should use during the study. Additionally, we offered a diary booklet and asked participants to log daily muRedder usage, such as time,

occasion, and title of the song. On the last day of the study, we visited participants' homes to collect the materials and conduct exit interviews. Each interview lasted approximately 30 minutes. All interviews were semi-structured. Details of the interviews are summarized in Table 2. For back-up data, muRedder was designed to log the date, the time when a ticket is inserted, and the title of the music to be saved in an SD card as a ".txt" file. This information would allow us to identify when and how many tickets were used during the field study.

Interview day	Interview contents
Introduction	- Music consuming habits (number of playlists, routine, taste of music)
Day 1	- Expectation towards muRedder after testing one ticket.
	- Usage context of muRedder.
	- Order of tickets used.
	- Overall emotional feedback.
Exit Interview	- Difference in the musical experience while using muRedder compared to other digital devices.
Day 7	- Other remarks and recommendations. (e.g., target, context)

Table 2. Summary of interview questions during the study

Data Analysis

We fully transcribed 454 minutes of interview recordings. We analyzed data by affinity-diagramming and through our research team's iterative process of grouping. During categorization, interview content was first classified into 17 groups, and then we divided them into two topics as follows: the impact ephemerality on the music-listening experience and the influence of physicality on music selection. Afterward, within each topic, data were grouped into detailed categories according to the similarity of answers, including meaningful insights about listening, selecting music, and sharing experience with other people.

FINDINGS

First, we used log files and diary notes to identify contexts in which people used muRedder (Table 3). People used muRedder in various situations of daily life that depended on each participant's daily routine. We could see that people commonly used muRedder while relaxing (e.g., before going to sleep/work and after showering/dining). In terms of the ticket consumption, eight participants used all nine songs

during the study, P10 left one ticket unused, and P8 left five tickets unused. In the middle of the study, four participants requested additional tickets. However, we did not provide additional songs to see how scarcity affected their experience. Most participants (N=9) also showed their willingness to use muRedder after the study. Their reasons included the grinding noise, play music by holding and putting the song ticket to muRedder, to be more immersed in listening to new songs of their favorite artists or enjoy the act of selecting the songs. Every participant had their personal device for music-streaming service (e.g., mobile phones). However, knowing that songs can only be played once, participants seemed to have made their time and circumstances ready to listen to muRedder. In the following subsections, we will disclose how participants experienced muRedder in their everyday lives.

Searching for Time and Space to Tune in to Music

muRedder was mostly used during relaxation time, and we identified that the nine participants purposely searched for specific times of the day or spaces in which to listen to music using muRedder. P8 mentioned, *"I use muRedder mostly when I'm just sitting in the living room rather than when I'm busy. This suits the mood when I feel like being alone without any disruption."* Moreover, P6 waited until bedtime to listen to her favorite song using muRedder: *"Sara Bareilles' 'Gravity' is my favorite. So I played the song just before I went to bed because it was a time I could fully concentrate on the music, and it was great!"* Many participants reported that they saved their favorite songs for later, more appropriate times, and used unfamiliar ones at first. Furthermore, recorded live songs attracted users to focus on the music. P10 remarked, *"I found that I was focusing more on live music because it felt like someone recorded from the show. I could feel the liveliness, and it was very exciting."* muRedder is devised to play music only once, irreversibly, and such limited functionality might have conveyed the ephemerality of a live show.

Ephemerality and Scarcity Draw Prudent Selection

We designed muRedder to evoke the ephemerality of sound by physically destroying the music tickets. Paper tickets and a ticket book exhibited how many songs remained, and a shredding speaker provided fleeting sound by destroying the tickets. The physical representation of ephemerality and scarcity influenced participants to become more thoughtful in choosing songs. P5 stated, *"Each song is special. Once it is used, it goes away.... It made me pick more carefully than I do on my cell phone."* Interestingly, the limited availability and

Figure 4. muRedder in situ. (a) P1's dormitory room, (b) P5's shared house, (c) P8's family's living room

ephemerality of sound presented the “fun of worry” in listening to music. As P7 stated, “Because I can listen to each song only once, I became prudent about selection, but I felt excited. Whereas Mp3 players are less exciting, because I don’t have those worries [about what to select]. I think it was funny that I was worrying.” Furthermore, many participants used muRedder consciously; they reserved song tickets for later and better reasons. According to P6, “When I’m using a music app [on my phone], I don’t care much in selecting which music to listen to, because I know it’s always there. But with muRedder, I feel like I should use it only when I strongly want to listen from it.”

Context	No. of Songs	No. of users
Relaxing (e.g., After work, while drinking, after shower before sleep, etc.)	40	9
Before going out (e.g., While dressing up, putting makeup on, etc.)	10	7
To watch shredding process	11	3
Dining (e.g., Preparing meals and while eating)	9	4
Cleaning	2	2

Table 3. Number of songs used in each context sorted by number of users.

Tangibility Draws a Sense of Ownership and Social Interaction
muRedder was designed as an ambient form of media rather than a personal device. Thus, it promoted conversation within families and friends. People recalled that they negotiated with their peers in selecting songs to make sure everyone enjoyed the music. During the discussion, they looked at the ticket book together to select the songs that they all liked and wanted to hear, or to engage in debate about the song that would best match the current mood. Family members also shared their music consuming preference in relation to their past experiences. For example, P7, P8 and P10 recalled that their parents were already familiar with using LPs or CDs and quickly understood the practicality of a music player with tangible interaction. However, the family members were not excited about using the device. P10 recalled, “My father saw its value from a business point of view, as these paper tickets must be really cheap to produce. But both my mother and father preferred a mobile device for its convenience.” Conversely, our participants were in their 20s, a demographic that is used to consuming music through digital streaming services and, at the same time, primarily affects the recent revival of vinyl records [31]. Arguably, muRedder reintroduced the sense of ownership with physically embodied digital music. P6 stated, “An album jacket in a CD shape feels like I possess the music tracks, which I have not experienced with MP3 files or from a streaming service.” Interestingly, some participants regarded physical media as better than

digital media to retain music. P10 stated, “These tickets are real objects, so they have a value as a collection and they feel somewhat safe. I feel that digital files are prone to be removed accidentally.” Furthermore, this ownership has caused a few participants (N=5) to hesitate about discarding the remnants of physical song traces. P9 mentioned, “I just thought why I should throw it away, so I didn’t. Because when I see the traces I think of the time and the song that I listened to, and even later it seemed like I could think of the song [some] more.” P6 stated that he would be upset if the remaining traces needed to be thrown away because those are the songs that he carefully selected.

A one-week field study using the tangible and ambient media inspired participants to explore other potential contexts. Cafes and pubs were recommended as the most appropriate places where music and social interaction become mutually embedded into the space. Other than commercial music content, participants also wished to use it to record audio messages and personally played tunes and to customize the ticket designs.

We identified that muRedder brings different musical experience into our domestic settings. Having spatial, temporal and functional limitations elicited thoughtful consumption of digital content. Moreover, we could see that users saw the music file as their possession and tangibility of the media evoked social interaction among the user groups.

DISCUSSION AND DESIGN IMPLICATIONS

In this section, we will discuss design implications for ephemeral music media and other potential areas that muRedder might be usefully exploited.

Slow Consumption of Ephemeral Digital Contents

HCI and design communities have long been explored how to design emotionally durable products [4] and increase the value of digital technology with ‘slowness’. muRedder reintroduced pause, contemplation, and reflection to the people’s fast music consuming habits. Remnants of physical traces in muRedder allowed users to reflect on the memories attached to the contents. This may encourage slow and reflective experiences during the use of technology, which aimed at enhancing emotional attachment between the user and the product rather than efficiency in performance [8]. Furthermore, ephemerality of both digital content and physical token has elicited thoughtful and slow consumption, whilst becoming highly focused on the content. This could also be enhanced by employing delicate and vulnerable materials in the design of user interfaces [12]. Moreover, muRedder brings ephemeral musical experience into our daily settings. Enjoying music tracks that are unable to replay from one’s home might present liveness or ‘fun of worry’ in domestic musical experience.

On the other hand, a limited experience is also inevitable when this ephemeral song player becomes users’ only musical device. Thus, the roles of this device for an ephemeral experience must be clarified when it coexists with the use of online music streaming services. As shown in the findings,

muRedder is not simply understood as a replacement for digital music listening methods, but also as a way to meet the needs of ephemeral music consumption in our everyday lives (although users were able to listen music through their smartphones). In this regard, for the design of slowness and social engagement in digital music consumption, a consideration of integrating and balancing tangibility, scarcity, and ephemerality features in the products or systems merit careful investigation. As these features are linked to each other, highlighting one aspect in the design of future musical systems could provide opportunities for new designs or help researchers to understand the value of a certain feature. In addition, time-based and aesthetic materials are key elements of ephemeral user interfaces [5], and the interaction can be enriched from the design of tangibly represented digital content. In designing the tangible device for ephemeral interaction, it is important to consider matching the visual appearance (e.g., color, pattern or shape) of the physical material with the device and enabling the consumed remnants to be visually consistent not to be seen as a waste. Also, as we determined the time of shredding according to the length of the song, users were able to watch and think about their consumption. Leveraging the disappearing time and the aesthetic visualization of the physical material during its consumption will lead to novel design of tangible artifacts for the ephemeral use of digitally stored data.

Furthermore, this ephemeral experience of digital content could provide new design opportunities by specifying the target and use context. We imagine that the future target may include people who want to participate in event-like music-listening experiences, who want to hear a specific song by making it a routine/certain situation during their daily lives or who want to introduce a specific song to others. This event-driven music listening experience can be used as a purpose to provide an episodic scenario by enabling users to choose the listening situation in their daily lives. As recommended by our study participants, muRedder has potential to be employed in public spaces, such as, cafes and pubs, like how jukebox has been used. muRedder would also promote social communication in live shows or gigs. The song tickets can be used as a self-expression medium for the people at the gig, calls upon conversation, and some limited-edition ones might be cherished, saved, or exchanged with other people.

Customizable Ticket Expands Applications of muRedder

During the interview, participants remarked that they had a sense of special ownership over the songs, which they knew that copies are available in the Internet. Tangibility of the song ticket transformed the ordinary music content unique and personal. Customizable ticket has a potential to reshape our ordinary social interaction with digital media. Users of muRedder might also embed personal messages, dairy, stories, as well as self-created music into the ticket and exchange as a gift. Digital contents are often less cherished or perceived as a gift when exchanged online due to many undermined surrounding social rituals, such as, thoughtfully selecting, wrapping, and save as one's keepsake [11]. We envisage that

muRedder will allow users to rematerialize the digital contents by crafting the physical token and exchanging it with peers, personally. Unlike USB sticks or other storage media, we argue that muRedder can be utilized in private and intimate social relationships to share personal experiences.

LIMITATION AND FUTURE WORK

The purpose of using the shredding mechanism was primarily to indicate the amount of music consumed. Environmental impact caused by paper traces and disposed RFID tags is a limitation of the current version of the prototype. In the future, we will improve muRedder by applying visual code recognition methods rather than RFID tags to identify music tracks. We will also employ reusable or recyclable materials to design the song tickets. Dissolving and evaporating water-soluble paper would be another approach to designing song tickets. Water evaporation would be yet another way to remove the waste and visualize the volatility of the sound source. However, this method needs further study regarding the health and safety issues because printed particles might dissolve into the air.

CONCLUSION

We introduced muRedder to explore how the notion of ephemerality, scarcity, and limited functionality transforms our ordinary musical experience. We studied muRedder with 10 participants in three different types of households. We employed the ephemeral and irreversible nature of sound to enhance the temporal experience. muRedder enabled users to focus solely on the music content and to actively find time and space to enjoy the music. We also found that scarcity of the media draws prudent decision making in selecting music. Moreover, the tangibility of the media creates a sense of ownership of the music tracks and promotes active social interaction between peers. Based on the findings, we propose new implications for designing future ephemeral interfaces that tangibly show the process of consuming otherwise invisible digital content. Moreover, we can confirm the further possibilities of slowing consumption by displaying physical remnants and providing memorable participation in public spaces.

ACKNOWLEDGEMENTS

This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (MSIT) (No.2.190311.01) and by the 'Promotion of Graduate School of Creative Design Engineering' of the Korea Institute of Design Promotion with a grant from the Ministry of the Trade, Industry & Energy, Republic of Korea (N0001436).

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