Metronome Music Time Capsule: rematerialising music consumption and exchange

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ABSTRACT

The dematerialisation of music consumption is a well evidenced and widely accepted trend. Though much literature has been produced discussing the economic and legal implications of this significant shift for the music industry, its impact on listening practices and consequent considerations for interface design are less well researched. This paper outlines the development of a prototype system that explores, symbolically, the interplay between contemporary dematerialised modes of music consumption with listening traditions of the recent past. A pre-internet age metronome was repurposed as a tangible interface for a custom music player containing 25 songs, drawn from the period 1940 to 2012. Together, the controller and software reflect through sound, graphics and physicality the progress of Western commercial music, technology and society over this time.

CCS CONCEPTS

• **Applied computing** → **Sound and music computing**;
• **Human-centered computing** → *Interface design prototyping*; *Social content sharing*;

KEYWORDS

music, playlists, dematerialisation, materiality, tangible user interfaces

1 INTRODUCTION

Annual global revenues from digital music sales (downloads and streaming) overtook those from physical sales for the

first time in 2015 [6]. Overall revenue also increased by 3.2 percent, suggesting that the phonographic industry had negotiated the dual threats of internet piracy and medium fragmentation (eroding commercial validity of the album format) posed by dematerialisation [11]. This steady transition towards formalised online distribution has been accompanied by a growing commercial and technological interest in playlists as the emerging mode of music consumption.

Most computer science research in this area has focussed on the development of playlist recommendation systems, for example through music information retrieval (MIR) techniques and/or collaborative filtering algorithms [5]. That focus is not the topic of concern for this paper. Instead, this paper relates closely and contributes to two areas that have received more limited attention. The first concerns the possibility that, despite dematerialisation of the medium, materiality still pervades music consumption practices. The second regards the exploration of aesthetic, cultural and social motivations that inform contemporary use of playlists. Both of these dimensions are important considerations that should be addressed in future human computer interaction (HCI) work on music playing software or playlist management systems.

Metronome Music Time Capsule (MMTC) has been developed as a prototype to investigate these two separate but related concepts of materiality and playlist utility. The system presents a tangible interface for navigating a customised digital music collection. Its design and conceptualisation deliberately aim at juxtaposing technology of the pre-internet age with typical digital music player design principles. Fixed playlist content has been conceived to represent a chronological thread that is both narratively constructed and complementary to the features of the interface. The physically encapsulated form of the MMTC playlist means that it can be shared with users in a manner akin to material playlists of the past (i.e. mix tapes or CDs), but consumed through a laptop or desktop PC. When presented as an installation piece, MMTC aims to illustrate and support two existing research contentions. First, it highlights that materiality in music consumption patterns has shifted from media to hardware.

Second, it demonstrates that music exchange in the form of purposefully tailored collections is still of social value.

2 RELATED WORK

Materiality

A growing body of research has highlighted the persistence of materiality in digital music consumption practices. Magguda notes the introduction of the personal MP3 player and portable hard drives in shaping listening habits and providing new markers of individual identity and status amongst young Italians [9]. Kumar and Parikh provide a detailed account of how digital music storage on mobile phones — which also engender a sense of attachment and social footing — led to disintegration of local music distribution economies in India [7]. Although debating how much this allure of digital devices is down the nature of the objects themselves, rather than their function, Beer reiterates the notion that materiality continues in our use of mobile media systems [1]. He argues that these objects are so subsumed into our routine physical practices, so intertwined into our personal histories and so emblematic of cultural capital, that the concept of material attachment still has to be considered in any understanding of dematerialised culture.

Playlist creation and exchange

Cunningham, Bainbridge and Falconer analyse the aesthetic judgements, organisational decisions and broader motivations that typically feed-in to the human process of playlist creation [2]. They draw a distinction between the character and function of a *playlist* (typically of indeterminate length, for personal use, potentially multi-purpose and with content that is suited to randomisation) and a *mix* (often of a predetermined length, to be shared or gifted, with a specific theme or occasion in mind and content arranged in a fixed order). They note that MIR and collaborative filtering algorithms are well-adapted to generating playlists, but that these techniques are not so applicable to mix creation, where construction is based on fluid, competing and interactive aesthetic principles that are insufficiently understood and inadequately modelled. They see only a supporting role for automated track recommendations and suggest further work to develop mechanisms that aid manual organisation.

Hansen and Goldbeck examined the principles behind playlist construction through structured analysis of their creation. They suggest a need for mechanisms that quantify the overall value of a playlist using three component factors - *item value effects* (e.g. track rating or likelihood of user approval), *co-occurrence interaction effects* (e.g. level of synergy and/or diversity) and *order interaction effects* (i.e. relative and absolute positions). They also assert that current

Figure 1: Metronome Music Time Capsule interface

technologies are best directed at assisting, rather than automating, collection creation, which is "an important form of self-expression and a social act that would lose its meaning if completely automated" [5]. Similarly, Sintas et al. go so far as to argue that "sharing music helps to integrate people according to cultural principles" [12]. A specific example of this is evidenced by Sinclair and Green, who suggest that the recommendation and social networking features of streaming services are partly responsible for converting the group they identify as *ex-downloaders* to a legitimised form of digital consumption [11].

3 SYSTEM IMPLEMENTATION

A JSH TM88 electronic metronome was repurposed as the interface for a musical archive of 25 pieces, at intervals from the past 75 years. When connected to a computer with the MMTC program running, the BPM values on the metronome dial recall a recording from the corresponding year (i.e. 40bpm = 1940; 76bpm = 1976; 112bpm = 2012, etc.). The six position slider on the device scans the current selection at linear time intervals, scaled to skip evenly through the length of the active track. On-screen graphical data is updated as the user navigates the years and pieces.[1]

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[1]The code repository for the system, an accompanying schematic and the playlist database file are available at https://github.com/rishi-s/MMTC.

The concept of MMTC inverts and plays with a fundamental musical principle. In music, a metronome dictates the temporal aspects of what is heard. Conversely, MMTC uses individual pieces of music to define a particular point in time. The chosen songs represent that chronological moment, as artistic "accounts" of the technology, genres and social forces in play. Two key objectives motivated the design and development decisions for MMTC:

Objective 1: creating a satisfying material interface

To explore the continuing influence of materiality in digital music consumption, the design of the interface aimed to provide a novel and pleasing physical interaction integral to the listening experience. The inherent features of the original device lent themselves well to this objective. Although manufactured at the beginning of the 1990s, its two controls had a mechanical dimension that made it closer in spirit to the design principles of the 1940s than those of the 2010s. The concept of transporting the user to different points in time could therefore be introduced at the very first point of interaction. Housing the unit in a wooden casing was also relevant in two ways:

- containing an Arduino board and custom circuitry to enable unhindered use of the two controls
- echoing the "time capsule" paradigm in the materiality of the design

Objective 2: compiling content of broad appeal

To investigate the ongoing social relevance of human customised playlist sharing, the collection was drawn almost exclusively from one author's existing personal collection. Only 3 of the 25 tracks were specially acquired to fill positions in the playlist — those for 1940, 1942 and 1969. All pieces were specifically selected to showcase stylistic, technological or social developments characteristic of the given year and that reflect a progression from what is heard before. This historical, narrative approach was taken because of its powerful metaphorical relationship to the object, but also for its conceptual accessibility to potential users. The chronological organisation presented identifiable touchpoints (i.e. years), at least some of which could be immediately accessible and of referential significance to most.

Hardware

The JSH TM88 device was deconstructed and its dial, slider and LED components rewired to interface with an Arduino Uno. The Arduino was programmed to provide serial communication with the MMTC software via USB and to control the two existing LEDs, which lit when the device was detected (red) and when playback was started (green).
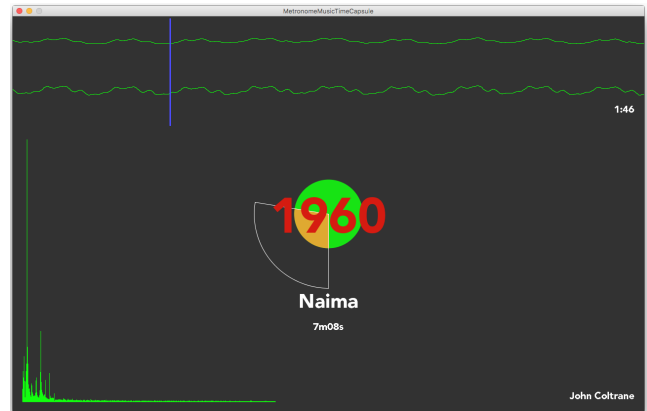

Figure 2: Metronome Music Time Capsule music player software

Software

A software media player was developed in Processing and designed to receive and send ASCII control messages from and to the Arduino. The Minim audio library was incorporated to handle all audio playback, analysis and metadata functions[2]. The coded solution used a .csv database to store track and year information, so that alternate playlists and chronologies could potentially be determined by any user.

4 EVALUATION

MMTC was presented during a showcase of prototype interactive multimedia technologies at Queen Mary University of London. 20 attendees were observed actively engaging with the device over the course of the two hour exhibition. Passive participant observation was used to gather and record information on user interactions and responses. Levels of engagement and enjoyment from MMTC users were seen to be high. All observed participants were witnessed navigating through the chronology of tracks to some extent, with most skipping back and forth through a range of the chosen pieces. Four people were noted very deliberately listening to each of the 25 pieces. Comments were not actively invited from users, but despite this several participants voluntarily provided feedback on their experience.

Objective 1

Nine users expressed satisfaction or interest in the tangible aspects of the design. Comments alluded to what would be commonly recognised in HCI theory as the *perceptible affordances* of MMTC's interface [4]. The repurposing of the dial

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[2]The audio analysis elements of the program were adapted from example assets in the Minim library. Specific attribution and explanation of these is given both inline and in the header of Processing code in the linked repository.

for moving through time (analogous to a clock) and the horizontal orientation of the slider (equivalent to linear progress through a specific medium) made for intuitive and confluent interaction by users. This high proportion of unprompted feedback on the physicality of the device supports the contention that materiality continues to be a consideration in people's experience of consuming music.

Objective 2

Six users expressed enthusiasm or curiosity in the choice of tracks. The nature of these reflections pertained to the characteristics and attributes of individual selections, the overall conceptualisation of the playlist and the audible sense of progression between pieces. This spontaneous feedback from a small sample of users directly relates to each of Hansen and Goldbeck's three proposed factors for use in assessing the value of a collection — namely, *individual item values*, *co-occurrence interaction effects* and *order interaction effects* [5]. This feedback, plus the significant level of navigational interaction that has already been described, support the view that sharing human determined playlists (a.k.a. mixes) continues to be of social interest and relevance.

Future work

These small-scale initial findings provide a basis for more structured investigation around the principles of materiality and playlist culture using the MMTC prototype. The experience of the MMTC trial can also be drawn upon to inform other experimentation in the design of tangible interfaces for playlist interaction, which is currently quite limited. Gallardo and Jordà have outlined their tangible system for music collections, which combines the use of playlist cards and a multi-touch tabletop surface with graphical projection and optical detection underneath [3]. Mailvaganam [10] has explored potential applications of haptic interaction design in a prototype playlist controller. MMTC adds to this sparse design-led research work.

One additional dimension that MMTC points to for further exploration is the application of material exchange of digital music collections in contemporary cultural contexts. The argument for supporting this ongoing social activity has been laid out in this paper. However, ideas for new scenarios and modes in which these types of interchange might occur in the future need creative thought and investigation. For instance, could there be a place for low-cost, legitimised, novelty modes of digital music exchange through material objects, which replicate the mix tape and CD "gifting" culture of days gone by? [3]

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[3] Jaron Larnier envisages a market for artists to distribute digital music releases through adapted consumer products, called *songles* [8].

5 CONCLUSION

This paper has outlined existing evidence for the continuing influence of materiality in patterns of digital music consumption. It has also shown how the human practice of playlist creation and sharing is a key part of musical and social culture, but one that is not currently well-supported by digital music distribution technologies. The MMTC prototype directly addresses this appetite for tangible modes of custom music playlist exchange through a single interface with a physical metaphor. Potential avenues for further research have been identified in the area of tangible interface design for playlist interaction. Creative investigation of these insights in research and development of music consumption technology is also advocated.

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