~~General~~ Purpose: Thoughts on Designing Successful Tabletops

Ben Bengler
University College London
Intel ICRI Cities
UCL Interaction Centre
Gower Street, London, UK
b.bengler@ucl.ac.uk

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Abstract
This paper argues that a shift in perspective - from general-purpose to highly specific - holds the biggest potential for successful tabletop applications. Key aspects proposed are *purpose*, *technical integration*, and *re-thinking the audience*. We reflect on these aspects, and illustrate them using *Collidoscope*, a table-based sound installation we developed, which generated widespread public interest. Amongst others, a video posted online has reached a audience of over 14 million since November 2015.

Author Keywords
Tabletops; Design; Tangible Interfaces.

ACM Classification Keywords
H.5.2 [Information interfaces and presentation]: User Interfaces – Input devices and strategies.

Introduction
Rather than brood over why tabletops have not progressed into mainstream, this paper deliberately abandons the idea of tabletops as general-purpose devices. Instead of 'benchmarking' tabletops against smart phones or tablets, the aim is to reflect on features that make tabletops unique and provide strong opportunities for successful designs.

Figure 1: *Anatomage Table*.
© Anatomage, with friendly permission.

PURPOSE – What's wrong with niche?

The question why tabletops have not become mainstream, general-purpose devices implies the expectation that this was their anticipated path. But wasn't it the lack of real-world purposes that tabletops struggled with from the very beginning? Widely referred to as 'interactive coffee table'[1], 2008's Microsoft Surface allowed users to swipe through photo collections, pinch and zoom video clips, or tag and interact with devices such as their phones. While similar types of tasks provided a rich resource for HCI research to study, develop and improve interaction styles, design guidelines or entirely novel interaction techniques, e.g. [5] – the related applications were commonly not strong enough candidates to warrant real-world use.

Importantly, tabletops had a key role in helping us to explore and understand real-time co-located interaction and collaboration with digital information, and how digital and physical representations can be blended seamlessly to support a variety of novel interactional spaces, e.g. [4]. While the acquired knowledge is still key for collaborative computing scenarios, in terms of technology, many of these scenarios can now be more effectively addressed by collections of devices such as phones and tablets.

Today, I argue, tabletops' true power lies in niche applications that make use of their unique features that can not be substituted by tablets or phones - such as size, shared visibility and access. One example is *Anatomage Table*, a life-size, virtual anatomy table designed as educational tool for the medical community. It combines a operation table form factor with an interactive anatomy visualization system allowing for virtual cadaver dissection.

[1] e.g. *Popular Mechanics* (31/7/07) http://www.popularmechanics.co.za/tech/the-coffee-table-that-will-change-the-world/

INTEGRATION: Let it disappear!

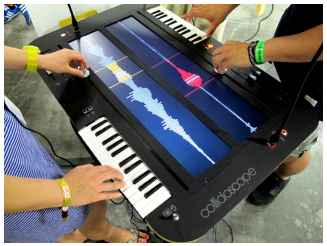
Once free from the 'yoke' of general-purpose, application regains priority over technology – rather than asking *'what else can we do with tabletops?'*, the question becomes *'what specific application benefits best from tabletop elements?'* An example for such an application-driven approach was *Reactable*, with its core technology component (*reacTIVision*) developed in response to a specific application in mind [2], resulting in a solution which inspired the wider community for years to come.

Importantly, giving up on general-purpose allows us to fully integrate tabletop elements (e.g. large displays) with application and physical controls into hybrid interaction surfaces, combining the best of both worlds. In this way, I argue, by letting the tabletop 'disappear into' the very purpose of its application, we can best harness its specific virtues.

AUDIENCE: Watch me doing it.

From Ed Dillinger's large touch-sensitive, widget-based desk in Disney's 1982 *Tron* to a multitude of interactive tables and control panels in the last forty years of cinema and TV – it's no coincident that we saw tabletops on screen long before they became a technical reality, as it allowed us - the audience - to closely follow and understand the actor's manipulation of the digital.

While most research has focused on active participation of multiple users, it's important to recall that tabletops also can serve audiences in other ways which tablets or phones can't. Extensive visual access allows observers to closely attend the operator's actions – irrespective of whether they'll become active participants themselves or remain passive spectators. For example, a demonstrator can use *Anatomage Table* in a lab session with medical students where expert demonstration is followed by active participa-



How it works: Via built-in microphones, players can record real-world sounds (e.g. their voice) into *Collidoscope* and then explore these using large sliders alongside the sound's displayed waveforms.

In this way, players can move through the sounds, play it back at different speeds, 'freeze' it at a particular position, loop parts of it, or layer sound snippets on top of each other. This results in novel sound textures and timbres, which then can be played via the keyboard, allowing for both musical and explorative interaction.

tion, or in an auditorium as hands-on demonstration tool in front of a larger audience.

Using the proposed aspects (purpose, integration, audience) as a lens, the following case study discusses design and audience response to *Collidoscope*, an interactive tabletop installation that generated widespread public interest.

CASE STUDY: Collidoscope

Collidoscope is an interactive, collaborative musical instrument that allows users to seamlessly record, manipulate, explore and perform real-world sounds (see sidebar).

Design

Purpose: The key purpose behind *Collidoscope* is to enable non-expert users (e.g. museum audiences) to record, explore and experiment with real-world sounds in a direct and immediate way. The approach was to develop a non-expert tool for *granular synthesis*, a real-time audio manipulation technique for independent control of pitch, speed and format characteristics, typically used in expert software packages (e.g. for pitch and time adjustment or as creative effect). To make this expert technique accessible to a general audience, the objective was to design an interface that closely represents the underlying sound manipulation process in a non-technical way; participants should be able to see, understand and experience *'what is going on'* at any point during their interaction.

Integration: To archive this, *Collidoscope* provides a high level of integration between user interface and application, both on a conceptual and technical level. On a conceptual level, the user interface is based on a strong coupling between visual and haptic cues and affordances that closely map onto the underlying digital process. For example, metaphorically speaking, while recording, the sound

Figure 2: Collidoscope ©DoctorMix

gets 'sucked into' *Collidoscope* by visually building up in the waveform display in real-time. The long horizontal slider then acts as a physical play head that allows participants to explore the recording on a seemingly 1:1 scale. In terms of technology, interface features are implemented using different modalities, depending on suitability; a tabletop display for sound visualisation closely matched with physical sliders that afford exploration, and musical keyboards as well-known interface to manipulate pitch.

Audience: Another key design goal was to convey *'what's going on'* not only to active players, but equally to spectators observing the interaction e.g. bystander in a museum. In an exhibition setting, bystanders can closely follow the actions of players, allowing them to learn and understand how the system works simply by watching what is going on. In a performance situation - i.e. when used by an experienced musician - this tackles the 'black box problem' of electronic music performances related to the opacity of performer activity; for example, in live laptop music it is often difficult for the audience to understand what effect the performer's action have on the music created [1].

Figure 3: *Collidoscope at Ars Electronica 2016.* *credit tom mesic*

Figure 4: *Detail: waveform display.*

About: *Collidoscope* was developed by Ben Bengler and Fiore Martin at the Centre for Digital Music, Queen Mary University of London.
Web: http://collidoscope.io/

Audience Response

While *Collidoscope* proved to be a very successful public installation shown at major international art venues and festivals, it was the reaction of the online audience that was truly surprising. In November 2015, a music technology blog published a video of *Collidoscope* via its Facebook channel. The video instantly went 'viral' [3], reaching 4 million views in the first 24 hours, and to date has reached an online audience of over 14 million.

When reflecting on why *Collidoscope* causes such strong public attention, I argue that this is largely due to the aspects discussed in this paper. A unique feature of tabletops – comprehensive visibility – was the basis for this, providing extensive visual access to the sound manipulation process to both co-located and online viewers. It appeared that the viewers' attraction was strongly related to their immediate understanding of how the instrument works, and how player's action result into the sound created, supported by the highly-integrated, hybrid tabletop interface.

Interestingly, despite being designed with a general, non-expert audience in mind, there was a particular strong reaction from music-tech savvy communities such as musicians and electronic music producers. While many expressed their interest in using *Collidoscope* both in live and studio settings, others speculated that it is probably 'absurdly expensive' and that they can archive similar results by using various (expert) software packages. This showed that due to its high level of integration and fidelity, many viewers perceived *Collidoscope* as a product ready for sale, rather than an interactive exhibit or installation, leading to purchase requests from both individuals and retailers.

While undoubtedly a huge online interest is only one aspect of a potentially successful application (e.g. commercially), it clearly shows how passionate and exited the general public still can react to tabletop applications that strike a chord with them. In this sense, I believe that it's the highly idiosyncratic applications that have the highest chance of success, keeping in mind that serving specialist purposes does not necessarily preclude their appeal to broad general audiences.

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