Multitouch Interactive DJing Surface

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ABSTRACT

Disc-jockeys have come a long way but, as far as DJing tools are concerned, there are still few applications that support hands-on interaction over Virtual DJ systems, and those are typically reduced to traditional input devices. With direct user-feedback from an accompanying group of DJ experts accounted for, we propose a Virtual DJ system with natural interaction, paired with a low-learning curve and an emphasis in user-oriented design. Finally, in order to draw conclusions on the adequacy of multitouch towards DJing, our prototype was compared against standard DJ solutions by a panel of DJ experts.

Categories and Subject Descriptors

H.5 [Information Interfaces and Presentation]: I.7; H.5.2 [User Interfaces]: Interaction styles—User-centered design, Graphical user interfaces

General Terms

Natural User Interfaces, User-Centered Design, DJing

Keywords

DJ Software, Multitouch Surface, User-Centered Design

1. INTRODUCTION

DJing has always been teamed up with technological advancements: turntable, DJ mixer, CD-player, and the new state-of-the-art DJing systems [4]. These tools, commonly called DJ setups [8], play an explicit role in defining the DJstyle. Through our research three major setup are identified: the Traditional, Virtual and Hybrid.

Although Virtual DJing applications have a handful of advantages (e.g.: digital audio processing and weightless environment), they are typically bounded to traditional interaction, mainly using input devices such as keyboard/mouse or dedicated hardware controllers. Such applications have

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. ACE '10, 17-NOV-2010, Taipei, Taiwan Copyright (© 2010 ACM /10/11...\$10.00 high learning curves, because mapping virtual actions is not trivial to users acquainted with traditional DJ gestures.

We aim to bridge the gap between Traditional and Virtual setups, through the development of a multitouch interactive DJing application where user-feedback from an accompanying group of DJ experts is accounted for. The proposed system merges the benefits of Virtual DJing applications with natural interaction found in Traditional DJing setups, rather than relying on typical input devices. As presented throughout this document, there are related works with a similar scope, but none actually addresses the touch-design challenges in DJ tasks to ensure a hands-free interaction.

Throughout this work we will: present the background required to understand the core concepts of the DJ's mental model; discuss related work that is relevant to our proposal; propose an architecture that fulfils DJ's requirements; and design natural interaction metaphors to DJ tasks. Finally, we evaluate the implementation from a critical perspective.

2. BACKGROUND

Chronologically speaking, the three DJ setups considered here represent different evolution stages of DJing tools. The Traditional setup, introduced more than three decades ago, utilises analogue devices, typically two turntables and a signal mixer [8]. This gear allows users to exercise direct bimanual interaction on the hardware, but forces them to travel with complex and heavy equipment that requires technical maintenance.

Later that setup was virtualized into a software application, hence denoted a Virtual setup. Although criticized for its non-natural interaction based on traditional input devices (mouse and keyboard), interviews with our accompanying group have shown that DJs praise them for the inclusion of features that are not available in the Traditional setup, such as: DJing-aid tools, improved visual feedback, digital processing, weightless data storage, audio plug-in integration, and so forth.

Recently, an effort has been done to minimize drawbacks in the Virtual setup. This Hybrid $setup^1$ is the union of the aforementioned setups. In rough terms, it functions as

¹Denoting the setup as "Hybrid" adds more meaning from an HCI perspective and it is coherent with Bell [3]. However, in DJ terms it is called Vinyl Tracking System for technical reasons.

a digital control system, allowing the user to operate a DJ application by direct manipulation over traditional components. Although this system solves the non-natural mapping found in earlier Virtual setups, these solutions triggered, once again, the need for limited analogue equipment with high acquisition, maintenance, and transportation costs.

3. RELATED WORK

As a result of recent developments in post-WIMP interaction paradigms, new trends appeared, mainly in the academic community, that use touch, tangible or glove interaction metaphors for DJing or realtime audio manipulation context.

Representing the tangible paradigm, Audiopad [13] offers a set of physical objects allowing the user to manipulate audio playback. In the same vein, the Reactable [11] provides synthesis and loop-based collaborative performance using tangible objects and multitouch. Although the implementation of scratch in the Reactable [7] showed surprising results in musical expression, it led to the conclusion that mapping new metaphors to DJ experts is difficult, due to user expectations and their mental model for turntable behaviour. These solutions successfully incorporate the paradigm of loop manipulation and sound synthesis; however, none was developed towards the context of DJing.

On an orthogonal perspective, DJammer [14] and Music-Glove [9] provide synergies between flexion, optical, and accelerometer sensors to create scratch-capable gloves. Overall, these solutions show an increased learning curve, requiring DJs to learn a new set of gestures that may not easily match their mental models.

Recently, a few products which take advantage of multitouch situations towards DJing have been proposed; the Lemur controller [10], which allows users to control a Virtual setup through touch with on-screen projection, is one of them. Its interface includes widgets that users may re-arrange to create custom setups but, being detached from the DJ's performance, forces users to manage the interface with an offline editor [1, 5]. And, being a proprietary system, it is impossible for the end-user to create new widgets. Also, in order to attend for a wide-range of different needs (e.g.: music production, sequencing), Lemur does not specifically target DJ tasks. Also using a multitouch interface [6] allows to scratch several sources simultaneously; and it enables to perform turntable-crossfader combinations with just one finger but, although this enhances scratching performance, it generates a new faderless lexicon that was not easy to some DJs.

In conclusion, these multitouch-enabled systems pave the way for a flexible multitouch solution suitable for the DJing context, one that we present and evaluate throughout the next sections.

4. MULTITOUCH DJING

In this section we present an overview of our solution at two distinct levels: architecture and interface. At the architectural level, we propose a modular architecture, which is able to address the technical requirements of DJing. At the interface, we focus on the interaction with touchable DJ objects.



Figure 1: Diagram of proposed architecture.

4.1 Architecture

The details of the architecture are shown in Figure 1, with all modules separated by functionality and structured in four layers: **core** (application), **managing**, **API** and **device**. External components (both hardware and software) interact with the system through their respective APIs, while communication events are routed through the core application. Separability of the modules ensures that the audio module is executed in a high performance environment, setting the latency around ≈ 23.6 ms. Extensibility is achieved by relying on the OSC and MIDI, allowing it to communicate/control existing DJ solutions and by providing easy integration with VST and LADSPA audio plug-ins.

4.2 DJ Interface

Our UI design, shown on Figure 2(b) is based on the core concepts in the user's mental model: sound sources, records, audio manipulators (volume faders, equalizer knobs, crossfaders, and so forth) and, finally, on relationships between these objects. These concepts are directly mapped into visual representations (of the objects) that the DJ can manipulate within a live performance. All the objects on the interface can be rotated (with snapping angles), moved or scaled using handles located around them, while manipulation can be locked to avoid accidental movement. This allows users to exercise creativity and design custom setups not possible with existing DJ solutions. Furthermore, side panels allow new objects to be placed into the scene in realtime; these include records from a touch browsable catalogue, or new components (e.g.: turntables, sliders) that can be routed by the DJ by drawing "virtual cables" from the endpoint connector of an object to another.

With input from the accompanying group we aim at maintaining consistency with the current DJ tasks by ensuring correlation with existing DJ gear and with identified DJ gestures. We also improve DJ performance, e.g., supporting multitouch points on the faders, so that a user can jump from one point to another and easily recall the first position. Other advantages over standard traditional setups include placement and scaling of objects, allowing users to exercise a precise control over several parameters with just one hand, and instantly jumping to a slider position without



(a) Expert testing (b) Prototype User Interface

having to drag the fader cap, enabling fast crossovers.

The choice of an horizontal multitouch surface brings a handful of advantages that can be used to maintain relationships with the user mental model and enhance musical expression level, namely:

Figure 2: Overview of our proposal.

- **Horizontal interaction** DJing with analogue gear has always been performed on a horizontal table. Therefore, the tabletop is a suitable surface for the DJ task.
- Natural Input Multitouch tables accept the exact input that real systems have, human-hand/finger touch, and output a visual representation of real systems.
- Multitask operation Research has demonstrated that parallelism that results from two handed-interactions can increase task performance [2, 12] and outperform selection via mouse-devices.

5. USER EVALUATION

Evaluation was carried out using a panel of ten DJs, where four were amateurs with two years of experience and 6 were professional DJs, with up to twenty years of knowledge, such as the user shown in Figure 2(a). The DJs were not part of the accompanying group, to ensure that no previous knowledge would interfere with the test outcomes. From our previous survey on DJ performance, we understood that different styles of DJing have specific application-requirements and result in different DJ performances, and therefore we opened the DJ group to include Scratch and Club/Radio-DJs. This section describes the test methodology and analyses the results in a critical view, extracting information to validate our proposal regarding DJ-oriented multitouch interfaces.

5.1 Test Description

The tests were structured in three stages: a pre-test questionnaire to determine the DJ profile and experience regarding multitouch devices; three DJ-oriented tasks; a post-test questionnaire to rate ease of usage and finally an interview to get detailed feedback of the interaction level. With the consent of all users, tests were videotaped, application audio was recorded, interviews were transcribed from audio recording and the application was logging events to a dedicated text file with timestamps for detailed error analysis.



Figure 3: Comparison of each task ease-of-use on our system vs. on typical DJ setups.

The tasks were designed to fit the basics of modern DJing, essentially focusing on mixing songs. For an homogeneous analysis, all DJs used the same two songs in each task (mid tempo songs, around 100 beats per minute). The first task was designed to understand how DJs operate a progressive mixing, by aligning two songs together, with no restrictions given at this stage. Thus, on this task, the DJ was free to use all of the interface objects available in the testprototype, namely: channel faders, cross-faders, standard DJ triple equalizers and the sound sources, represented visually by two turntables. This freedom of choice allowed us to understand which objects are preferred for a typical mix, regarding the different DJ styles. The second task studies a limited interaction, hence we asked DJs to mix the two songs just using the faders without equalization. And finally, for the third task we set out to study fast DJ gestures, such as fast cross-fading between two songs and stopping and starting consecutively two different songs. This last test allowed us to measure the application's adequacy to a more scratchoriented performance.

The DJs were asked to rate the perceived ease of use for each task when compared to the systems they use (Traditional, Virtual and Hybrid). The scale was set to 1-5, with the lowest score representing a system which is much harder to use while the highest represents one that is easier to use. Multi-tasking was also measured by video analysis and data logging to determine where the user takes advantage of bimanual interaction to perform two different tasks at once.

5.2 Results

Evaluation allowed us to gather some interesting results. In Figure 3 we compare the scores given by the panel of DJ experts after completing the tests. We noticed that, with the given tasks, there was no meaningful difference in the ratings against the Traditional or Hybrid, so both were collapsed into a single variable. However, if other tasks, such as record selection, are chosen for the future tests, traditional and Hybrid setups should yield different results when compared to our system.

Figure 3 denotes the mean values of each score, showing that overall our system is appropriate for any DJ who is familiar with any of the three setups, because results lie above the medium score, meaning that the system is at least as easy to use as the compared one. The standard deviation (σ) give us a clear insight of the fluctuations of the scores for each task.

Comparing each task against the Virtual setup we witnessed a surprisingly good result. The fluctuations of the test scores are low, while the mean is always above 4 points, thus ensuring that DJs found advantages in our proposal when compared to the Virtual setup. Against the Traditional (or Hybrid) setup the σ shows a more meaningful value, making the scores fluctuate higher. Analysing each DJ's score set in comparison to the Traditional, the lowest scores were rated by the Scratch expert DJs, while Club-DJs found the system in tune with their expectations. This confirms the hypothesis that a multitouch device will suit a wide number of DJ styles (such as Club or Radio), but will fail against the mental model of Scratch-DJ users.

Also, when looking in detail at tasks 1 and 3 in comparison with Traditional/Hybrid setup, we can see that the σ decreased in the latter task, because the majority of the DJs found that manipulating a multitouchable fader has some advantages when compared to an analogue fader². The highest rate of bimanual interactions was detected when the DJs needed smooth transitions, specially using fader-knob combinations on each hand, which relates directly to task 1.

On a final note, we believe that test results show that the interface was built using the DJ core concepts and can be easily used by DJ experts. Remarkably, although 60% of users had no multitouch-enabled devices and the remaining percentile uses multitouch mobile-phones or drawing tablets, we found no statistical correlation between the scores of those with previous know-how. Also, all users were able to carry out their tasks successfully and within their own time/quality expectations.

6. CONCLUSIONS AND FUTURE WORK

We proposed and evaluated a multitouch DJ setup, based on a hands-free interaction metaphor close to the DJs' mental model. Through user testing, we captured how users can relate to multitouch in order to execute a live DJ performance, identifying advantages and weaknesses over the existing setups. We concluded that it suits both Club and Radio expert DJs, but lacks the haptic-feedback that Scratch-DJs expect.

As conclusions are drawn from test analysis, they can be applied towards new prototypes. The upcoming version will also consider the inclusion of features that make it stand out as a full fledged DJ application for mixing and beatmatching. All of these features together will enable DJs to exercise creativity, creating scenarios that are not possible in the real world.

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 $^{^{2}}$ As mentioned, most DJs understood that they can trigger fast motions by touching the desired endpoint for the fader position.