The Reactable: Tangible and Tabletop Music Performance

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Abstract

In this paper we present the Reactable, a new electronic musical instrument with a simple and intuitive tabletop interface that turns music into a tangible and visual experience, enabling musicians to experiment with sound, change its structure, control its parameters and be creative in a direct, refreshing and unseen way.

Keywords

Music performance, tangible interaction, tabletop interfaces, musical instruments, Reactable, ReacTIVision.

ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms

Design, Experimentation, Performance.

Introduction

In recent years we have seen a proliferation of tangible and tabletop interfaces for musical performance. The trend started with the millennium with projects such as the Audiopad [11] or the Jam-o-drum [1], but nowadays so many 'musical tables' are being produced

that it becomes difficult to keep track of every new proposal. Above all, the Reactable [6,7] has accomplished unparalleled mass popularity if we consider its academic origin. With demos watched millions of times on YouTube and having reached the 'real world' and the rock stadiums after being hand-picked by Icelandic songstress Björk for her 2007 world tour, the Reactable has made many people aware of the existence and of the potential of tangible interfaces, and it has also turned into one of the very few new digital instruments that have successfully passed the research prototype state. Is it just a coincidence that other 'hype' and 'cool' new commercial musical devices, such as JazzMutant's Lemur and Toshio Iwai-Yamaha's Tenori-On [10], albeit not strictly tangibles, do also remain so related to many key TUI concepts? We do believe that this current musical tangible and tabletop vogue is not only a consequence of Web 2.0 viral mechanisms, but that there are instead many essential reasons, such as collaboration and control sharing, and the potential of tabletop interfaces for real-time, multidimensional, continuous and high-bandwidth interaction, which turn live music performance and tangible interaction into promising and exiting fields of interdisciplinary research and experimentation [7].

Music Controllers
Dedicated interfaces for digital music performance or music controllers, as they are commonly called, have existed for years. They started to proliferate two decades ago with the advent of MIDI, and there is an ever-growing interest in this field. As a sign of this tendency, the annual conference on New Interfaces for Musical Expression (NIME) started in 2001 and now gathers annually more than two hundred researchers, luthiers and musicians from all over the world to share

their knowledge and late-breaking work on new musical interface design, a field which depicts fundamental differences with its acoustic counterpart.

Interactive Music and Laptop Performance
In traditional instrumental playing, every nuance, every small control variation or modulation (e.g. a vibrato or a tremolo) has to be addressed physically by the performer. The musical computer on its side is a system endowed with memory and knowledge, capable of handling semi-autonomous tasks. Its performer no longer needs to control directly and permanently all the aspects of the sound production, being able instead to direct and supervise the computer processes which control these details. As a result of the potential intricacy of these ongoing processes, performing music with computers often tends towards an interactive dialog between instrument and instrumentalist. These new type of instruments often shift the centre of the performer's attention from the lower-level details to the higher-level processes that produce these details. The musician performs control strategies instead of performing data, and the instrument leans towards more intricate responses to performer stimuli, thus allowing musicians to work at different musical levels and forcing them to take higher level and more compositional decisions on-the-fly [5].

Most of the music controllers currently being developed do not pursue however this 'multithreaded and shared control' approach, prolonging the traditional instrument paradigm instead. Many new musical interfaces still seem highly inspired by traditional ones, most often designed to be 'worn' and played all the time, and offering continuous, synchronous and precise control over a few dimensions. A conceptual distinction that recalls Marshall et al. [9]

'ready-at-hand vs. present-to-hand' recent discussion on the benefits of learning with tangible interfaces ('While engaged activity is important for learning so too are periods of disengaged reflection').

Tangible Music Interfaces and Musical Tabletops

Tabletops interfaces, as surfaces in which objects can be alternatively grabbed or left, do certainly excel at the former feature. Furthermore, in the aforementioned 'shared performance' model in which performers tend to frequently delegate and shift control to the instrument, all affordable ways for monitoring ongoing processes and activities are especially welcome. Visual feedback becomes thus a significant asset for allowing this type of instruments to dynamically 'communicate' the states and the behaviors of their musical processes [4]. Cockpit displays may not be strictly essential for piloting a jet but how many pilots would choose to fly with their displays turned off? And yet, not many new musical interfaces profit from the display capabilities of digital computers, which takes us again to tangible interfaces.

Tangible User Interfaces (TUIs) combine control and representation within a physical artifact [12]. In table based tangible interfaces, digital information can become graspable with the direct manipulation of simple objects that are available on a table surface. This can be attained by combining the tracking of control objects on the table, with projection techniques that convert the table into a flat screening surface. A table with these characteristics can favor nearly unlimited multi-parametric and shared control, interaction and exploration, multi-user collaboration, while it can also contribute to delicate and intimate interaction (e.g. moving and turning two objects with both hands). Moreover, the seamless integration of

visual feedback and physical control, brings a more direct, natural, intuitive and rich interaction, that can fulfill many of the special needs brought by the new live computer music performance paradigms.

The visual feedback brought by these interfaces, can partially solve another relevant problem of laptop music performance, such as the perception difficulties and the lack of understanding these type of concerts provoke in the audience, which could be synthesized as 'how could we readily distinguish an artist performing with powerful generative software tools, from someone checking their e-mail whilst DJ-ing with iTunes?' [3]. With the help of cameras and screens, new tangible musical instruments such as the Tenori-On, the Lemur or the Reactable are in fact bringing the physical performance back to live computer music.

Introducing the Reactable

The Reactable is built upon a tabletop interface, which is controlled by manipulating tangible acrylic pucks on its surface. By putting these pucks on the Reactable's translucent and luminous round surface, by rotating them and connecting them to each other, performers can combine different elements like synthesizers, effects, sample loops or control elements in order to create a unique and flexible composition. As soon as any puck is placed on the Reactable's surface, it is illuminated and starts to interact with the other neighboring pucks, according to their positions and proximity. These interactions are visible on the table surface that acts as a screen, giving instant feedback about what is currently going on, turning music into something visible and tangible. Additionally, performers can also change the behavior of the objects by touching and interacting with the table surface, without a limit to

the number of fingers that can be used simultaneously. The Reactable was specially designed so that it could be used by several simultaneous performers (which justifies its round shape), thus opening up a whole new universe of pedagogical, entertaining and creative possibilities with its collaborative and multi-user capabilities.

Figure 1. The Reactable

The way the Reactable works is deeply inspired by modular analogue synthesizers such as those developed by Bob Moog in the mid 60s. Reactable's pucks represent the building blocks of electronic music, each one having a different functionality in sound generation or in effect processing. While in modular synthesizers one typically had to connect these different modules with patch cables in a complex and error-prone process, on the Reactable this is attained in a much easier and intuitive way, since connections between the pucks are managed automatically based on their types and affinities and on the proximity

between them. As a result, one can construct any specific setup quickly and on the fly, by simply moving the pucks and bringing them into proximity with each other. Additionally, the resulting sonic flows are represented graphically on the table surface always showing the real waveforms that travel from one object to the other.

The Reactable's Hardware and Software

The Reactable hardware consists of a round interactive surface with a diameter of 90cm and a height of also 90cm. The tracking system, based on computer vision, can track numerous tagged objects and finger touches on the interactive table surface, where the visual feedback is displayed using a short-throw projector inside the table. The core sensor component of the Reactable is the computer vision tracking software reacTIVision, an open-source, cross-platform computer vision framework for the fast and robust tracking of fiducial markers attached onto physical objects, as well as for multi-touch finger tracking [2,8]. It was designed by Martin Kaltenbrunner and Ross Bencina at the Music Technology Group at the Universitat Pompeu Fabra in Barcelona, as part of the Reactable project.

Reactable History

The Reactable was conceived and developed since 2003 by a research team at the Pompeu Fabra University in Barcelona. Sergi Jordà, Martin Kaltenbrunner, Günter Geiger and Marcos Alonso presented their creation for the first time in a public concert at the International Computer Music Conference 2005 in Barcelona. After this successful introduction to the research community, the instrument got known to a wider audience when the team released several demonstration videos on Youtube in late 2006, which up to now have been

watched by more than four million people. This includes eminent musicians such as Icelandic singer-songwriter Björk, who after seeing the demonstration videos, successfully incorporated the Reactable on her last 18-months world tour Volta, where Damian Taylor played the Reactable at the big stage during about 80 concerts. In parallel, during the last three years, the Reactable team has given more than 200 presentations and concerts in more than 30 countries.
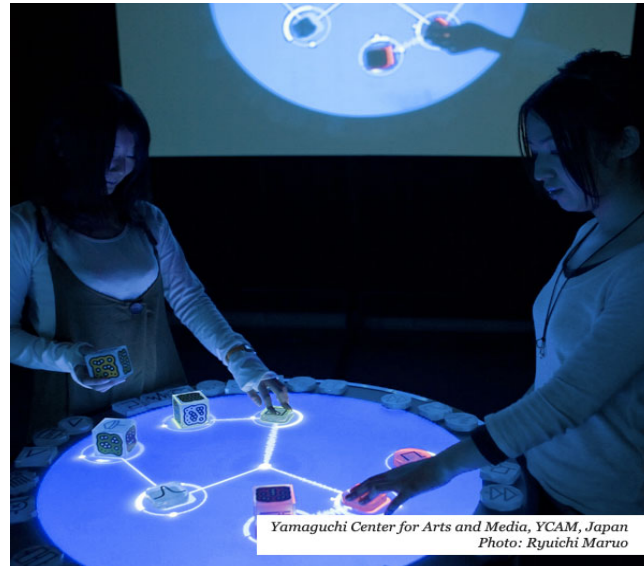

Yamaguchi Center for Arts and Media, YCAM, Japan
Photo: Ryuichi Maruo

Figure 2. The Reactable at the Yamaguchi Center for Arts and Media, YCAM, Japan.

Following an overwhelming response within the blogosphere, the Reactable was featured in various major TV and print magazines, becoming one of the most popular and worldwide acclaimed new musical instruments of the early 21st century. Declared the Hot Instrument of the Year by the Rolling Stone Magazine

(2007), the Reactable has also received several prestigious international awards such as the Prix Ars Electronica Golden Nica for Digital Musics (2008), two D&AD Yellow Pencil Awards (2008), the MIDEM Hottest Music Biz Start-Up Award (2008) or the prize Ciutat de Barcelona (2007). On February 2009, the creators of the Reactable founded the spin-off company Reactable Systems (www.Reactable.com).

The Reactable in Concert

In these last years, the Reactable has been featured in concerts all over Europe, America and Asia, being performed both by its creator team, and since April 2007, also by the musician and producer Damian Taylor who plays it on Björk's world tour 2007-2008, Volta. These extremely demanding situations have certainly helped turning it into a fully mature musical instrument, a fact that is not incompatible with its continual design process refinement and evolution. The instrument is used quite differently in Björk's tour and in our own concerts. Damian Taylor uses the Reactable to play specific songs with quite predetermined parts, which although open to some improvisation, have to fit within the rest of the band sound and timing. Our concerts tend to be more open, often completely improvised, and the Reactable, played by one to four musicians, is habitually the only instrument on stage. The stylistic range can also vary, depending on the venue, from strongly beat-oriented techno, to more experimental electronic music.

In our opinion, a very good balance between expressivity, richness and control has been attained with its design. According to Ullmer [13], the fact that most tangible platforms map interactive objects with physical world elements that have a clear geometrical

representation, often poses problems with respect to the scalability of such systems, in terms of the physical objects that can be realistically manipulated on a table, and the restricted level of complexity that can be handled within these restrictions. The Reactable deals reasonably well with this scalability problem: while two objects can often be sufficient for a "solo" intervention, the level of musical complexity that can be generated by a table full of objects can easily surpass the cognitive load of several simultaneous performers.

Acknowledgements

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