Radear: A Tangible Spinning Music Sequencer

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ABSTRACT

This paper presents a new circular tangible interface where one or multiple users can collaborate and interact in real time by placing and moving passive wooden pucks on a transparent tabletop in order to create music. The design encourages physical intuition and visual feedback on the music being created. An arm with six optical sensors rotates beneath a transparent surface, triggering sounds based on the objects placed above. The interface's simplicity and tangibility make it easy to learn and suitable for a broad range of users.

Keywords

sequencer, tangible interface, collaborative, interactive design, real-time manipulation

1. INTRODUCTION

Traditional music sequencer interfaces often rely on a screen or a row of buttons. The relative complexity of many sequencers, coupled with the lack of tactility in screen-based solutions, has encouraged designers to explore interfaces that are simpler, more intuitive, and more easily learned. The field of Tangible User Interfaces has contributed a number of new approaches to musical interface design based on physical interaction.

This paper presents Radear, a new tangible interface for music sequencing, replacing traditional step sequencer controls with an interactive and intuitive circular configuration. Performers can shape the music quickly and easily by moving small physical tokens around a transparent tabletop. A mechanical spinning arm equipped with optical sensors reads the location of the tokens and offers immediate visual feedback to the performer on the state of the system.

2. RELATED WORK

Previous work has suggested a number of design guidelines for tangible and collaborative music systems. When creating participatory musical interfaces for the general public, the design should be as simple as possible to minimize the amount of time needed to understand the interface [2]. As previous studies attest [5], simplicity of interface design can nonetheless give rise to musically sophisticated results.

The circular shape of a collaborative instrument makes it equally accessible from any point as observer or participant [3]; the Circular Optical Object Locator (COOL) [8] adapted this concept as a cooperative music-making device. The behaviour of this device is closely related to Radear as it has a rotating platter. The user manually spins the platter and puts pucks on its surface which are detected by a camera mounted above the instrument. In contrast to the video image processing of COOL, Radear uses near-field optical sensors which allow a sub-millimetre measurement of the distance from sensor to reflective object [7]. Blaine's Jam-O-Drum, another multi-user instrument [3] allows novice and musically experienced users to collaborate around a shared tabletop surface. Like Radear, visual feedback is an important component of the system, helping participants understand the operation of the device. Another similar multi-user instrument is Daisyphone [4], a screen-based circular sequencer allowing multiple users to collaborate remotely.

One of the most well-known tangible musical interfaces is the reacTable [6], an interactive tabletop instrument for multi-user collaboration. Objects are placed on the table surface; the objects themselves are passive but computer vision techniques identify the type, position and orientation of each one on the surface, allowing each object to have a different function. Polymetros [1] takes a different approach to multi-user music creation, using three Novation Launchpad controllers with additional visualisations and controls. By comparison to this previous work, the Radear system is quite straightforward, but its simplicity also carries the benefit of an immediate intuitive understanding for both performers and audience.

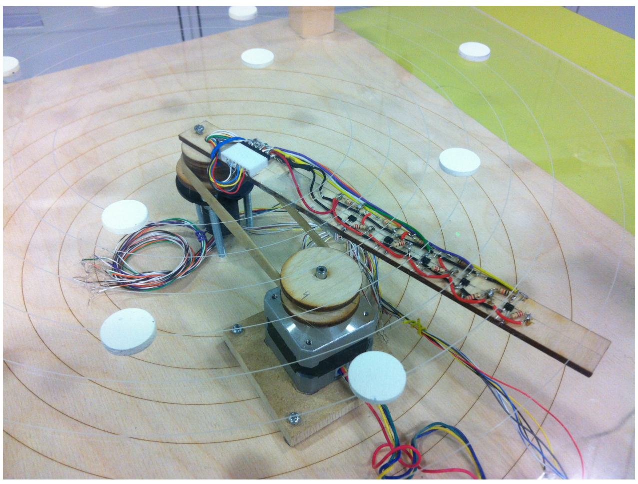

Figure 1: Radear's tangible interface

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3. RADEAR: A TANGIBLE SEQUENCER

Radear (Figure 1) is circular music sequencer built with six optical reflectance sensors attached to a spinning arm. One or more users can interact with the device by placing or moving reflective chips on the transparent surface.

3.1 Design

The device mechanism consists of three primary elements: one stepper motor, one slip ring and six optical reflective sensors. The motor and the slip ring are connected by a rubber belt. The slip ring enables the wires to rotate and the sensor arm to spin freely without becoming tangled. Support structures around the slip ring and stepper motor prevent the belt from slipping off.

A wooden arm containing six optical sensors is attached to the top of the slip ring. The sensors contain an infrared LED and a photo transistor which measures reflected light [7] and therefore, the distance between the object and the sensor. Any IR-reflective object will work with the sensors. An Arduino reads signals from the sensors; when an object is detected, a signal is sent to a computer to trigger a sound. Max/MSP is used to control the sounds, which are drawn from simple percussion samples, one for each sensor. Next to the tabletop lies a box with a potentiometer to modify the arm's rotation speed, and six switches to mute each sound individually.

A transparent acrylic surface rests above (but not touching) the spinning arm. The surface has six engraved circles which illustrate the trajectory of each of the sensors. 2cm circular pucks are placed on top of the surface, with their location determining the timing of identity of the sound. The pucks are passive, which makes the interaction more fluid, since the participants do not have to worry about making an electrical connection or placing them in any particular orientation. The performer can also easily add and remove the chips in order to affect the music in real time. The engraved rings aid the performer in knowing where to place the chips, and the position around the circle intuitively corresponds to the position in the rhythmic sequence.

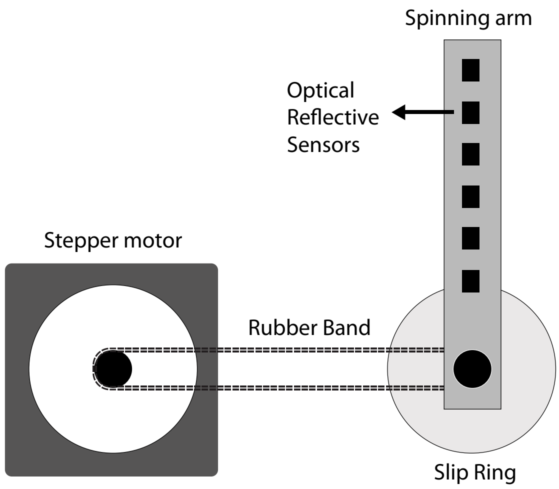

Figure 2: Diagram of Radear's mechanism

3.2 Interactivity

Radear aims to offer one or more users an easy and interactive way of making music. Its straightforwardness is part of the design goals, allowing anyone to use it, whether or not they are an experienced musician. The visual analogy (and the name) is inspired by spinning radar dishes, and the visual feedback is also an important part of the interaction. Moreover, having engraved rings on the surface makes the interaction and puck placement easy to understand.

The instrument was presented for a demonstration at Queen Mary University of London. It was observed that most users immediately understood its operation. Some of them experimented with different, idiosyncratic uses of the device, including throwing tokens randomly over the surface. The ease of manipulating wooden tokens gives the impression of playing a game, instead of playing a complex instrument; this led some people to join others in creating musical sequences together. Some participants suggested that the interface could be used for teaching children music. In order to start over and remove all the placed pucks, the participants just swept these passive objects from the tabletop.

4. CONCLUSIONS

In our informal study, we found that in many cases, the level of engagement was dependent on the musical background of the user. The more understanding of what was going on, the more time a participant spent playing the device. Nonetheless, the ease of use makes the instrument accessible to everybody without requiring any previous knowledge about sequencers or music performance. The tangibility of the interface and the simple passive pucks make interaction intuitive.

5. ACKNOWLEDGMENTS

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