Designing Collaborative and Mediated Experiences with Networked Circuit-Bent Devices

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ABSTRACT

Circuit bending provides creative methods of generating sound by subverting a device's normal operation through hacking. While the means of interacting with hacked devices in performance are primarily limited to tactile controls and explicitly mapped actions, exploring alternative methods of engaging with these instruments would allow for mediation systems and collaborative performance design to enhance the use of nostalgic devices in audio/visual art. This paper discusses the artistic benefits of blending the musical and aesthetic practices of circuit bending with the field of networked musical performance. We present the artistic benefits of traditional circuit bending and methods of extending networked performance techniques to the practice. This is followed by a discussion of Bendit_I/O—a framework for designing cyber-hacked readymades—opening the door to innovative design practices for using hacked hardware in collaborative environments. We also discuss *Pepper's Ghost*, a multimedia installation created with networked circuit-bent devices with the goal of exploring these concepts.

INTRODUCTION

The limitations that come with using hardware devices in musical practice also provide opportunities for giving them a second life once they become obsolete. Embracing and exploring the imperfections of electronic hardware is a core philosophy behind the practice of circuit bending: the act of modifying the internal circuitry of consumer electronic devices for the purpose of creating avant-garde audio or visual material (Skjulstad, 2016, p. 18). The defiant exercise of opening a blackboxed device (Hertz and Parikka, 2012, p. 426) exposes previously hidden and vital information on how its systems function, affording artists the chance to devise new creative uses for outdated technology. While a rich history of circuit bending continues to inspire artists today, the advent of Smart Musical Instruments (Turchet, 2018, p. 8944) and IoMusT devices (Turchet et al., 2018, p. 61996) that allow for more collaborative and accessible performance experiences asks us to reconsider how outdated hardware can continue to play a role in modern sonic art.

EXTENTIONS TO THE PRACTICE OF CIRCUIT BENDING

While recognizing circuit bending's impact in the realms of media art theory and avant-garde composition, we believe that there are elements of the practice that we can extend to provide practitioners with additional opportunities for performing their hacked devices. One such opportunity comes from removing the reliance on tactile performance interface elements. Performers have limitations in patching/modifying bends by close-range and/or tactile interactions with potentiometers, buttons, photoresistors, or patch cables (Collins, 2014, pp. 90-93). A.J. Gannon's circuit-bent Speak 'n' Spellbinder is an example of an instrument built around a traditional reliance on tactile interface elements (see Figure 1).

Figure 1: The Speak 'n' Spellbinder by A.J. Gannon.

Additional room for expansion rests in the realm of networked performance tools, which allow for collaborative artworks centered on multiple users modifying and contributing to each other's experience. Large-scale, multi-user DIY electronic instruments such as the SyncArmonica by LoVid and the improvisatory circuit-hacking performances by Loud Objects represent cases of collaborative experiences with simplistic or hacked hardware, yet these examples require tactile interactions with hacked devices and for all the users to share the same physical space.

To bring these extended techniques to musical hardware hacking, we have set out to explore new systems that can enable artists to design communal performance experiences (both local and telematic) between multiple users and multiple circuit-bent devices. The Bendit_I/O framework affords the same collaboration and interaction opportunities as custom-made Smart Musical Instruments and provides mediated alternatives to the explicit methods of interacting with hacked instruments. By connecting each hacked device to its own Wi-Fi-enabled Bendit board (see Figure 2), we can treat each device as a single performer linked over a local or remote server (Marasco, 2020, p. 52).

Figure 2: A circuit-bent camera connected to a Bendit board.

PEPPER'S GHOST: NETWORKED CIRCUIT BENDING IN PRACTICE

Using Bendit_I/O, we have developed *Pepper's Ghost*, a multimedia installation that exhibits a move beyond traditional circuit-bending performance techniques. In *Pepper's Ghost*, participants enter the installation space and are presented with a two-panel hanging scrim. On the opposite side of the scrim is a digital camcorder and a media cart containing a CRT TV and DVD player. Both the camcorder and the DVD player are circuit-bent with modifications made to the objects' image sensor and video processor circuit with Bendit_I/O boards respectively (see Figure 2). A projector displays different visual material onto each section. One section features a live video feed from the circuit-bent camcorder while the other section features a visualization of the control signals being passed between the devices on the network. Once participants approach the installation, they can modify the visual and audio outputs of the hacked devices through non-tactile means. This is achieved through tracking the participants positions with a separate camera. This tracking data is used to trigger the visual distortion of the devices, displayed on the TV and scrim.

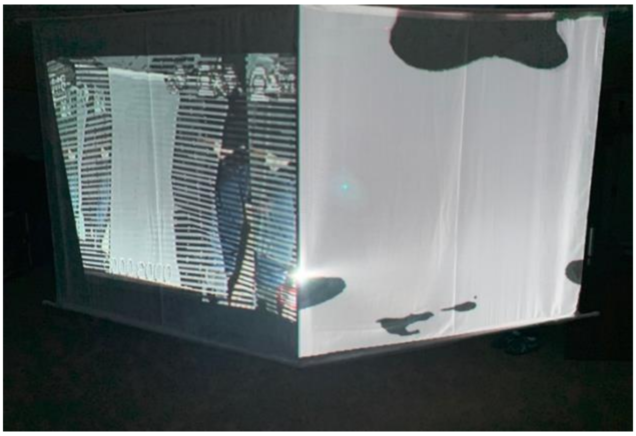

Figure 3: Dual projections in "Pepper's Ghost."

In addition to processing the video, we attach inductive pickups to both the camcorder and DVD player along with the Bendit_I/O boards. These pickups are used to amplify the inner workings of each device's manipulated circuitry; feeding this audio into a signal processing patch built in Max/MSP. Using the same data from the motion-tracking camera, we map the locations of participants in the space to audio effects applied to each pickup. When participants' locations are registered as being more dispersed a high-rate, high-depth flanging effect is gradually applied to the signal. As the number of detected participants in the space increases, the amount of reverb placed on the audio also increases. Inversely, when less people are present, the audio becomes more compressed and distorted. By using the same motion-tracking data between both the audio and visual elements, these changes are coordinated together. Through this, the authors work to sonically represent the interactions between the various hardware on the network and further emphasize the impact of the participant's non-tactile movements on the actions of the networked circuit-bent devices.

Figure 4: Video from a networked circuit-bent DVD player.

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