Intermodulator: interactive audio-visual system for collaborative improvisation

Laewoo(Leo) Kang
Information Science, Cornell University
Ithaca, NY 14850, USA
laewoo@gmail.com

CHI'18 Extended Abstracts, April 21–26, 2018, Montreal, QC, Canada

ACM ISBN 978-1-4503-5621-3/18/04.

https://doi.org/10.1145/3170427.3177760

Abstract
This paper describes an interactive installation called 'Intermodulator' that generates diverse patterns of moiré image through participants' collaborative and improvisational sound engagement. This installation is comprised of ordinary box fans, backlights, and microphones. The custom-designed system enables the speed of the individual fans and the brightness of the backlights to interact with different live sound inputs. When a certain resonance and tension are achieved between these input sounds, the installation produces seemingly stationary or moiré images of the fans. The main contribution of this installation is to suggest an experiential space where participants can (a) produce artistic audio-visual performances through collaborative improvisation, and (b) empirically explore the key features of collaborative improvisation that promote creativity and learning. This paper introduces the concept, background, and technical details of the project, and proposes its site-specific version for Satosphere Dome at the SAT[1].

Author Keywords
Improvisation; Collaboration; Sound Installation; Intermodulation;

[1] http://sat.qc.ca/en/satosphere

Light Exchange in Intermodulation
The backlights in Ⓒ side respond to the sound that Ⓐ performer produces. Likewise, Ⓓ side lights interact with the sound from Ⓑ microphone.

Figure 1: Intermodulator used by two musicians for an audio-visual performance (Powerdove and Sarah Hennies), Feb 2017

Laewoo (Leo) Kang is a HCI researcher as well as multimedia artist. By considering collaborative art practice as a useful mode of learning for HCI and design, Leo explores diverse socio-technological issues and possibilities through diverse artistic and collaborative practices.

http://www.laewoo.com

Introduction

Intermodulator is a sound responsive installation that produces diverse patterns of moiré image through participants' collective and improvisational sound engagement. The system receives and analyzes the frequency and volume of different live sounds, and map them to the speed of the fans and the brightness of the backlight.

Current installation is comprised of eight different modules of the fans, and each module is assembled by two fans that oppositely face to each other like a sandwich (Figure 2). Each side of fans is connected to two different sound inputs (mic Ⓐ and Ⓑ in Figure 1, 2), and this module assembled with an incandescent light bulb produces diverse combinations of fan images by responding to participants' sound (or music) engagements.

When a certain resonance and tension are achieved between these different inputs, the installation produces diverse patterns of moiré, which is visionary

Figure 3. Diverse moiré patterns in Neo Barc's In-the-Visuality, 2009

Although moiré is often considered as 'interference' or 'disturbance' in many areas including signal engineering, photography, and media broadcasting, some artists have actively employed it as aesthetic resources for their art works (Figure 3)

illusion caused by mutual 'interference' of two oppositely rotating objects or visual images.

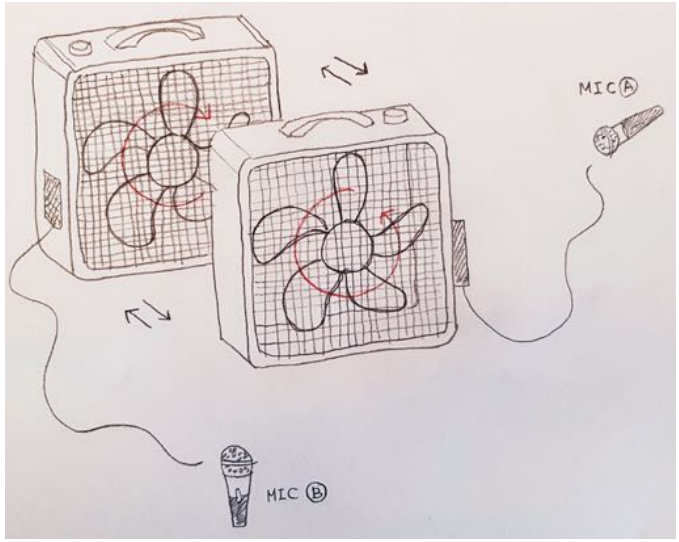

Figure 2: One module of Intermodulator responding to two different sound inputs. The speeds of individual fan are mutually affected by each other's sound.

Like a seesaw, which requires more than one person to appropriately enjoy it, its design of the system naturally and implicitly encourages people to use this installation in a collaborative format. This system also can be extended to multi-channel inputs by incorporating an audio-mixer through which more than two people can interact with the installation. Figure 4 shows its alternative version where eight participants collectively improvise with the installation.

By providing a heuristic space where participants can produce interesting audio-visual performances through collaborative improvisation, this installation allow people to empirically explore the nature of collaboration and improvisation that promotes group creativity and learning. More video examples of this installation can be found in the author's website.

Figure 4: Intermodulator extended to five channel inputs

Background

This installation was built in the process of our art-based research project titled 'Intermodulation [7] ' where different musicians, visual artists and HCI researchers collaborated to produce diverse audio-visual concerts from 2015 to 2017 in NY, USA. The main goals of this research were to understand the key features of collaborative improvisation that enable creative learning, and to explores the value and possibility of such artistic practice as a mode of HCI research and inquiry.

In this project, the author was engaged primarily as a multimedia artist, providing interactive artworks to accompany the performances of electronic and

Five key features of improvisation in our research

Reflexivity: It is constructive and reflexive learning processes reconstructed with shifts in the on-going environment.

Transgression: It invites unforeseen and uncertain factors as a mechanism of discovery.

Tension: Tension between structure and freedom calls forth unexpected moments of creativity and learning.

Listening: It involves engaging and synchronizing with collaborators, materials, and other circumstantial factors in the situation.

Interdependence: Improviser's cognition and behavior are co-constructed in relationship with other actors and the environment.

experimental musicians. Along with this art making study, we also had interview-based study on multi-media artists and musicians, including participated musicians, who engage processes of improvisation for producing their creative works.

One key lesson the author learned from this research is that collaborative improvisation has essentially 'inter-dependent' nature where participants actively listen to each other in the situation, and mutually adjusting their tunes depending on other's play. Especially, good improvisation, which promotes creativity and learning, is not only achieved by building harmonic and stable relationships between those who share similar interests, but also by exploring 'tension' between similarity and otherness, which may periodically give rise to kinds of 'interference' or 'disturbance' to each other.

Figure 5: Intermodulation with Powerdove, Nov 2016

Like two oppositely facing fans that mutually interfere each other's direction, like moiré image that appears in tension of interdependent engagement, such lesson on collaborative improvisation conceptually and technically inspire the design of Intermodulator.

Collaborative Improvisation in HCI

Derived from a Latin word meaning "unforeseen", improvisation refers broadly to the practice of composing or inventing extemporaneously, especially in the art and music fields, as a way of producing more effective, open-ended, and sometimes participatory aesthetic and creative outputs [9]. Outside the worlds of musical and artistic performance, the language of improvisation has sometimes been adopted to underscore the indeterminate and evolutionary qualities of everyday human behavior, and as such has begun to challenge and inspire work across a broad range of disciplines from anthropology, economics and cognitive science; to architecture and urban planning; to information and computer science [8].

In HCI and design, some theorists have emphasized the 'situated' and 'circumstantial' character of human action and its dependency on emergent material and social contexts in the use of systems and their design. For example, Suchman [10] describes how circumstances co-create intelligent action by rejecting plan-based models of human cognition then prevalent in Artificial Intelligence and HCI. Agre [1] builds on this insight to connect questions of determinate planning and action to the indeterminate properties of situations, which remain complex, non-transparent, never fully representable, and therefore genuinely uncertain. Dourish et al [4] build on these understandings of improvisation to argue they apply to the everyday action of designing itself.

Immersive Experience in Intermodulation

Our study shows that improviser's balancing between free play and group structure constitutes an essential 'tension' that can call forth unexpected moments of creativity, learning, and surprise. This tension generally involves a practitioner's emotional and intellectual challenges, which are produced from the uncertainty and unfamiliarity inherent in improvisation and collaboration. Recent studies on creativity [3] similarly explains this nature of human's creative aroused in highly focused and immersive mental state like 'flow', especially when appropriate challenges are given to the learner.

These theoretical insights also have been mirrored in turn by diverse methodological explorations in HCI research and design including research through design, critical making, and meta-design. These methodological suggestions commonly highlight the advantages of learning through open-endedness, situated engagement, and artistic collaboration. In addition, recent studies have begun to suggest ways in which learning from these improvisational methods can be made more accessible and generalizable forms of knowledge [6], both through processes of deliberate documentation and reflection [2], and the consideration of a range of intermediate artifacts [5]. However, there is still limited understanding of how improvisation works as a mode of research, and what features of improvisation enable learning and creativity. For extending such limitation of improvisation for HCI research, our research team have studied this artistic activity through theory, ethnography, and collaborative artwork.

Technical Details and Settings

The system of this installation is built by assembling diverse DIY electronic components. The PSSR/ZC Tail has been used for safe control of 120vac incandescent bulbs through zero-crossing detection. For analyzing the frequency and level of individual input sounds, Sparkfun's Spectrum Shield has been used. The speed dials in the box fans have been hacked and connected to four channel relay shields. These electronic components are connected to and controlled by the Arduino-based microcomputers. More than 2000W at 120VAC is required to run the whole installation.

Intermodulation for Satosphere

For the Satosphere dome in SAT, the author proposes the hybrid version of Intermodulator where its physical installation and software versions are presented together (Figure 6). Similar to its hardware version, the software version is proposed to produce diverse patterns of moiré through participants' collaborative sound engagement. These patterns will be duplicated to thousands of moiré images and projected to fill up the 360-degree spherical projection screen in the dome.

More than five microphones will be installed on the floor of the dome at regular distance. Diverse sound objects like a glass, old radios, broken objects, or music instruments will be prepared around the microphones for the audiences to pick up and engage in the installation. For sharing how creative outcomes are produced from this setup, the video or sound will be recorded during the exhibition, and exhibited through its official website. We can also suggest more performative version of this installation (based on the request) where improvisational musicians (like Powerdove or local improvisational musicians in Montreal) and participants collaborate to produce more professional and musical audio-visual performances.

Acknowledgments

This installation was built with much helps and inspirations from Powerdove, Yanpu Wu(MPS '16) and Sofie Cornelis(BS '19) .

Figure 6: (left) Floor plan of Intermodulator, (right) Software version of Intermodulator proposed for SATIE

References

1. Philip E Agre. 1997. *Computation and Human Experience*. Retrieved from http://portal.acm.org/citation.cfm?id=522884
2. Jeffrey Bardzell, Shaowen Bardzell, Peter Dalsgaard, Shad Gross, and Kim Halskov. 2016. Documenting the Research Through Design Process. In *Proceedings of the 2016 ACM Conference on Designing Interactive Systems - DIS '16*, 96–107.
3. M Csikszentmihalyi. 1997. *Finding flow: The psychology of engagement with everyday life*. Basic Books. R
4. Paul Dourish, Annette Adler, and Brian Cantwell Smith. 1996. Organising User Interfaces Around Reflective Accounts. In *Reflection'96*, 235–244.
5. Bill Gaver and John Bowers. 2012. Annotated portfolios. *interactions* 19, 4: 40. http://doi.org/10.1145/2212877.2212889
6. Kristina Höök, Peter Dalsgaard, Stuart Reeves, et al. 2015. Knowledge Production in Interaction Design. In *Proceedings of the 33rd Annual ACM Conference Extended Abstracts on Human Factors in Computing Systems - CHI EA '15*, 2429–2432.
7. Laewoo (Leo) Kang, Steven J. Jackson, and Phoebe Sengers. 2018. Intermodulation: Improvisation and Collaborative Art Practice for HCI. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems. ACM, 2018*.
8. George E. Lewis and Benjamin Piekut. 2016. The Oxford Handbook of Critical Improvisation Studies, Volume 1.
9. R. Keith Sawyer. 2000. Improvisation and the Creative Process: Dewey, Collingwood, and the Aesthetics of Spontaneity. *The Journal of Aesthetics and Art Criticism* 58, 2: 149. http://doi.org/10.2307/432094
10. Lucy Suchman. 1987. Plans and Situated Actions. *Cambridge University Press*: 224. http://doi.org/10.1002/asi.20714