Diligent Operator: The Resurrection of Musique Concrète with Max/MSP Jitter and Arduino

Byeongwon Ha

Virginia Commonwealth Unversity
Richmond VA, The United States
hab@vcu.edu

Abstract

Nam June Paik (1932-2006) exhibited the progressive music environment for audiences, *Random Access* (1963) in his first solo show. It allowed audiences to make their own sound collages by interacting with visual audiotapes on a white wall. This unusual music project was based on Paik's musique concrète composing experiences. Studying the practical relationship between *Random Access* and musique concrète, *Diligent Operator* (2016) develops Paik's idea of interactive collage music by employing Internet system to access a wide range of sound data all the world over. This new version of musique concrète was created with computer programming including Max/MSP Jitter and Arduino.

Keywords

Interactive Art, Nam June Paik, Musique Concrète, Random Access, Max/MSP Jitter, Arduino

Introduction

Diligent Operator encourages visitors to make sound collage music in real time by connecting black Ethernet cables as if visitors become 'diligent operators' in the operating switchboard system. *Diligent Operator* creatively reinterprets Paik's *Random Access*, which was exhibited in his first solo exhibition *Exposition of Music – Electronic Television* in Wuppertal, West Germany in 1963. *Random Access* allowed visitors to make sound collages by rubbing the strings of graphical audiotapes on a white wall with a mobile head of a tape recorder in a nonlinear way. This project is considered one of the most significant pioneering interactive art works (Paul, 2015).[1] Based on his research on musique concrète compositions, Paik employed the composing environment of musique concrète to make the interactive system for *Random Access*. Likewise, *Diligent Operator* is an academic creation that was developed from the study of *Random Access*.

[1] In particular, art curator Christian Paul (2015) focuses on Paik's reinterpretation of nonlinearity in art. She insists that *Random Access* predicted two-way communications between artwork and visitors.

Musique Concrète

Musique concrète is a pioneering style of mixing music developed in Paris during the late 1940s by French composer Pierre Schaeffer. This mainly emphasizes two intertwined elements, or a sound fragment and an acousmatic. A sound fragment is considered a discrete and complete sound object for compositions beyond our preconception (Schaeffer, 2012). Schaeffer pointed out sound fragments, which are 0.5 to 5 second-long fragmentary sounds from any sound data-base (Godøy, 2009) including recordings of everyday sounds like bells ringing, trains, and humming tops (Meigh-Andrews, 2006). By extracting specific sound from diverse sound sources, sound fragments are converted from objective to subjective sounds. The sound fragment is a fundamental unit for musique concrète, and one of the most remarkable achievements in Schaeffer's musique concrète (Godøy, 2009).

As conceptual artist Marcel Duchamp disconnected the fixed relationship between signifier and its signified, and created a new meaning in his 'readymades,' Schaeffer explored unlinking the preconceived relationship between sound and its original function, and listening to sound itself. In this regard, Schaeffer emphasized the subjective perceptual listening experience, acousmatic listening from sound fragments (Godøy, 2009). Acousmatic refers to a noise that one hears without seeing what causes it. Schaeffer high-lighted acousmatic from the Larousse dictionary, using Pythagoras who taught his lectures behind a curtain so that his disciples could only listen to him without seeing him. Like the curtain, Schaeffer thought that today the radios and tape recorders can play a similar role with an invisible voice. In other words, he insisted that the tape recorder had the virtue of Pythagoras' curtain, which created new phenomena to experience, such as audio independent of visual sources (Schaeffer, 2004). By discovering the instinctive paths that lead from the purely "sonorous"

to the purely "musical," this type of environment denies the instrument and cultural conditioning, and puts the sonorous and its musical possibilities in front of audiences (Schaeffer, 2004). Sound fragments based on acousmatic listening make musique concrète very phenomenological music due to direct sound experiences without visual and contextual references. To expand the phenomenological sound experience, Schaeffer's piles of records were decomposed, compressed, stretched, de-ossified, inverted, shattered and pulverized as if a child aggressively played with his toy (Schaeffer, 2012).

Nam June Paik's Musique Concrète

When Paik studied musicology in Munich in 1956, he was obsessed with new music in Europe. In particular, he focused on serialism, or twelve-tone music, which was developed by Austrian-born composer Arnold Schoenberg. The following year, he transferred to Freiburg Music Academy to be an avant -garde composer. It is not surprising that he was interested in a new form of music, electronic music. At the same time, he focused on musique concrète as the origin of electronic music. Paik visited Schaeffer's musique concrète studio in Paris on April 16, 1958. The main purpose of the visit was to use the studio for his musique concrète project under Professor Wolfgang Fortner in Freiburg (Paik and Steinecke, 1999). After coming back to West Germany, he wrote an article about musique concrète, "A report on the Paris Studio of Pierre Schaeffer and Musique Concrete." Paik thoroughly explored the history of musique concrète as a musique concrète composing researcher, as he mentioned in the end of the article. Paik concentrated on three qualities of musique concrète, composition with sound data, noise in music and the studio system for music. First, Paik mentions Paul Hindemith and Ernst Toth as precursors of musique concrète. In *Trickaufnahmen* (1930), Hindemith used several turntables to change the pitch of recorded sounds and mixed them to create new interactive rhythmic sequences, and Toth experimented with voices by manipulating volume and pace of the sound data (Holmes, 2012). In other words, they created a method to make meta-record music. Another quality of musique concrète, noise, is stressed by Paik: Italian futurist Luigi Russolo had already experimented with noise as a main element for music in the 1920s-30s in this article. In fact, Russolo presented his statement "The Art of Noises" in 1913. He highlighted that noise sound as the revolution

of music is paralleled by the increasing proliferation of machinery sharing in human labor (Russolo, 2011). Russolo did not reject noise as an obstacle for music. Instead, he stressed that composers would utilize this inevitable element for new music. Paik explained how Schaeffer mixed these two experimental methods, or noise and meta-music, to make musique concrète. Paik insisted that his contributions to experimental music became a critical seed for studio music and growing electronic music studios around the world. Paik emphasized that without Schaeffer, scholars could not write a history of contemporary music. Accordingly, Paik thought of Schaeffer as a very important pioneer in progressive music as a precursor of electronic music, which Paik had just become interested in.

Nam June Paik's Random Access

Random Access was exhibited in the basement of the Galerie Parnass during *Exposition of Music – Electronic Television*. *Random Access* consists of fundamental materials for musique concrète, or a tape recorder and its audiotape strings. It shows a visual collage of audiotapes on a white wall. Audiences were able to access sound fragments with a mobile head of a tape recorder in a nonlinear way. By rubbing the tape strings with the extended musical interface, visitors were actively able to compose collage music. Even though Paik used the electronic music studio in Cologne when he enrolled in the PhD program at the University of Cologne, he mainly used normal audio editing systems, which are similar to the Paris studio of musique concrète instead of expensive electronic music devices (Rennert, 2010). In Paik's article "Time Collage," he recollected the conversation with art critic Yoshiaki Higashino in the WDR studio in Cologne. When the critic visited the studio, he saw more than hundreds of audio strings hung on the ceiling. He was surprised that the cutting-edge electronic music came from a handcraft workshop that was reminiscent of a workplace in the medieval age (Paik, 1984). Along with this montage experience, Paik also installed a twin project of *Random Access* by switching audiotapes into another medium for musique concrète, 78-rpm records. In *Record Shashlik*, Paik threaded several records in two axes on a table. The appearance and function of it is similar to a hard drive. Just as with *Random Access*, audiences were able to access music data bases in a nonlinear way. *Record Shashlik* and *Random Access* showed two different

editing environments of Schaeffer's musique concrète studio. Paik invited visitors to virtual music studios of musique concrète. These installations were based on Paik's new idea. He quit the authoritative position of composer, and explored a new way to compose 70% of a score and leave 30% for audiences (Paik, 1963). Similarly, on the poster of *Exposition of Music – Electronic Television*, Paik wrote a sub-topic "How to be satisfied with 70%." It explains that Paik explored how to be satisfied with his unfinished projects or interactive art as a progressive artist.

His new idea allowed audiences more freedom to change the speed of reading the tape strings as if an artist paints abstract images on a huge canvas. In other words, Paik did not provide viewers with a final work, but made them take part in the process of creating collage music. This open work gave viewers active interactions. By providing audiences with diverse choices of sound databases, Paik created his own interactive pieces. In this regard, these projects can be considered one of the pioneering interactive art projects with electronic devices, which mix and manipulate different sounds in real time.

Dissatisfaction with Interactive Art

When Paik exclusively developed his interactive art *Random Access*, he published a two-page manifesto "About the Exposition of Music" to reveal his philosophical idea about interactive art. Even though Paik respected Cage and his colleagues, he did not like their music since their chance and indeterminate music were still fixed, at best a little open to performers (Paik, 1962). Unlike them, Paik explored to provide audiences with real freedom to engage in his project. In this regard, his interactive art started with how to escape a one-way communication in art and performance.

Currently, a lot of artists in the art-and-technology field have been using visitors' bodies as a critical interface to participate in their interactive projects. This popularity gains momentum with the release of *Kinect* as an interactive interface. Even though this was originally designed for users to physically interact with the video games of the *X-Box* console, artists appropriate the affordable interface in their interactive art. Some collaborative open sources simply allow *Kinect* and their programming to communicate with each other. Since the popular interactive interface has been released, the body has been popularly used for interactive art with a low budget and simple coding. With the infrared technology from *Kinect*, visitors' bodies disappear on the screen. Without their image, they can be immersed into the virtual reality designed by artists. The visitors' bodies often become invisible in current interactive works. Even though their hidden bodies are included in the project, in most cases, audiences just need to be immersed into its environment. In this regard, interactive art provides them with restricted freedom, or some limited interactions without a recognition of their identity. For this reason, their bodies tend to become a passive agent in current interactive art.
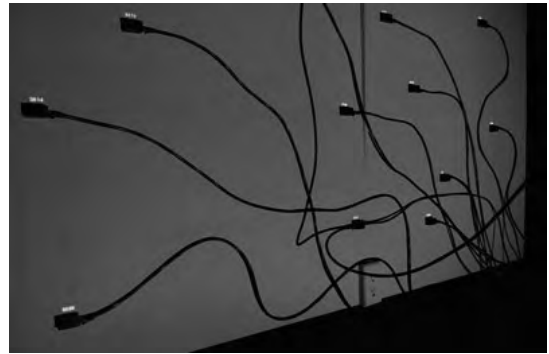

Figure 1. Diligent Operator ©Respect Copyright

Similar to participants in interactive art, common computer users are isolated in their own filter bubble on the Internet (Pariser, 2011). For example, video service websites such as *YouTube* and *Netflix* have the algorithms to accumulate the information about users. And then, they recommend specific video clips and movies based on each costumer's searching and viewing data. After all, they control users' activities online by analyzing their web surfing data. Due to this closed-circuit algorithm, users are getting more and more trapped in their previous data online. As data is getting bigger and bigger, costumers are paradoxically getting more passive with the regional and closed-circuit experiences in Internet environment, which people call World Wide Web. In 1984, although Paik broadcasted a worldwide satellite performance *Good Morning, Mr. Orwell* (1984) with diverse artists in both the East and the West, passive viewers are still limited in our regional and autocomplete boundaries.

Visitors in interactive art usually try to find the description for it, and follow the creator's description

to view their own contributions to predictably changing the creator's limited world without any reflections about their identities. Does interactive art really give visitors the freedom to choose? Or, does interactive art itself employ passive volunteers to activate it? Based on these questions, *Diligent Operator* suggests a negotiation boundary between a passive environment in interactive art and an active space in progressive music. Even though musicians practice musical instruments following the rigid rules, they can be creative performers while they master the instruments.

Figure 2. The input part of *Diligent Operator* ©Respect Copyright

Diligent Operator

Diligent Operator outstandingly makes an interactive acousmatic environment for visitors. It identifies passive recipients submitting to their filter bubbles on the Internet with conformists following the instructions in interactive art. In *Diligent Operator*, visitors become diligent switchboard operators in a hierarchical workplace in order to rethink their role as an interactive subject. In a recognizable similarity to Paik's *Random Access*, *Diligent Operator* uses the same strategy of Paik's interactive art, visual collage on a white wall with a movable interface. Instead of audiotapes, in *Diligent Operator*, 12 Ethernet cables are attached to the white wall. The end of each cable has a different changing four-digit random number image every 30 seconds. These 12 random numbers are generated in 12 sections of 833 or 834, which are equally split numbers from 0000 to 9999 into 12 regions to indiscriminately be selected. Each number represents a four-digit number for video camera data, or DSC four-digit number. If uploaders on YouTube do not type any titles for their video clips, the system automatically assigns the identical file names to their video titles. Since they do not have a real title and few information, most of them are could not be searched with any keywords except for the combination of DSC and the specific numbers. However, they are public videos, which every user can have access to. In other words, most of the video clips do not deal with secret or confidential messages, but show everyday life. For this reason, titles with DSC and four digit numbers are mainly documentations of their activities to share their videos with their family, relatives or small communities.

The computer commands visitors to connect a specific four-digit number among 12 random numbers in order to play sound fragments from the specific DSC video files on YouTube. However, audiences' shadows from the projector discourages viewers from finding the number. Their bodies make viewers uninvited guests in interactive art. To complete the computer's mission, they need to hide their bodies so as not to make any shadows on the numbers as much as possible. If visitors do not successfully follow the instruction by connecting the specific Ethernet cable on the white wall with an interactive interface, or a long Ethernet cable on the ceiling in 30 seconds, the random numbers and the instruction number change. If the visitors made it, the computer finds 32 YouTube video clips from a list of the search results based on the DSC number that the computer said, and randomly plays six of them without visual images.[2] The sound becomes a sound fragment liberated from its original function as musique concrète's collage sound. This is global collage music without our preferences. Each sound clip plays for ten seconds, and the following sound starts in the middle of the previous sound clip. In other words, visitors listen to overlapping sounds except the starting and ending five seconds. In addition, if uploaders for the video clips allowed to show commercials before them, visitors listen to commercials instead of their amateur videos. This collage between amateurish and professional sounds makes comparison sound, and underscores the home-movie-like sounds.

As opposed to the autocomplete function, following the computer's rule discourages visitors from interacting with their preferences. Following the computer's command makes visitors passive operators,

---

2   When the computer does not find enough DSC four-digit number titles on YouTube, it automatically includes similar titles based on its specific algorithm. As the four-digital number gets higher, the accuracy of the title gets lower.

but their interactions demolish their filter bubbles of autocomplete with the double random algorithm between a random number on the wall and randomly chosen video links on the collected list from the number. This provides visitors with random access to peripheral video clips, as compared to popular videos that users mainly visit. In other words, with physical computing and programming, visitors perform as a passive operator who navigates diverse video clips without their biased key-words. Their passive interactions paradoxically contribute to breaking their filter bubble, and allow them to listen to peripheral sound collages with random access. In the end, they become active musicians in the restricted world.
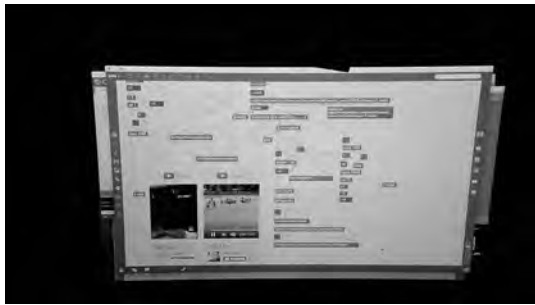

Fig 3. The Max patch of *Diligent Operator* ©Respect Copyright.

Technology of Diligent Operator

The physical computing part of *Diligent Operator* includes Arduino and Adafruit 12 Key Capacitive Touch Sensor Breakout - MPR121. This breakout board communicates with Arduino via I2C communication protocol, which uses only two pins, SDA and SCL pins, to interact with serial signals from diverse devices. This board allows users to use 12 capacitive touch sensors without building any parts with resistors, capacities, and pull-up or pull-down wires. To communicate Arduino with Max/MSP Jitter, this project simply uses the serial communication. Since Max/MSP Jitter is only required to recognize basic signals from the capacitive sensor, the program does not need an external patch like Maxuino. Each pin is attached to each Ethernet cable on the wall. Max/MSP Jitter simply generates 12 different four-digit random numbers, which are projected onto the wall. These numbers dim up and down, and change every 30 seconds. Their positions are adjusted to the end of each Ethernet cable by using the jit.gl.videoplane objects based on the openGL technology. When a

mobile Ethernet cable on the ceiling, acting as an input interface, is connected with any of these 12 Ethernet cables, the touch sensor board recognizes which cable is connected.
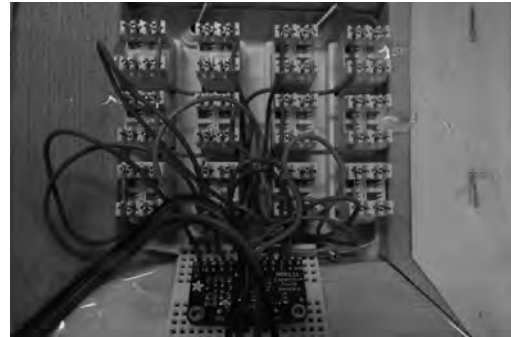

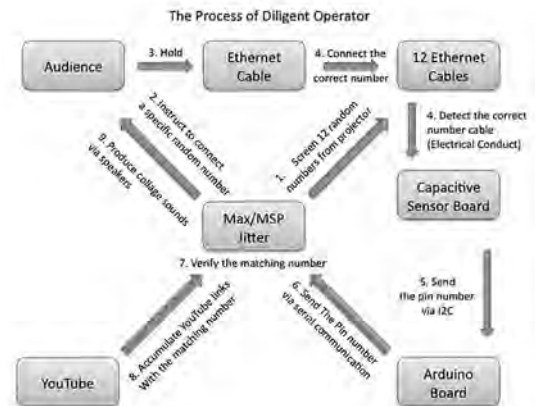Figure 4. The capacitive sensor for Ethernet cables ©Respect Copyright

Figure 5. The diagram of the process of Diligent Operator ©Respect Copyright

The computer commands visitors to connect a specific Ethernet cable, which has a specific number among these 12 random numbers. If visitors connect the right number cable with the mobile Ethernet cable hung in the ceiling after the instructions, the computer collects the addresses of 32 video clips with the title of DSC and the specific number on YouTube by using the coll object, and randomly selects six video links among them. By using the jweb object, which allows creators to incorporate Internet websites in their Max/MSP Jitter patches, participants can listen to collage music from the video clips. In other words, selecting the right four -digit number on the wall automatically leads the computer

to enter the DSC and the number on the search bar on YouTube, and randomly plays six of the videos on the list of the search results. However, their correct connection impacts the random order of collage music in *Diligent Operator*. Visitors' access moment decides the list and order of the final six video clips because Max/MSP Jitter generates random numbers based on the moment when users execute the random object.[3] The random number from the computer is intertwined with the random order of search results by participants.

Result

Interactive art mainly employs participants as the source of the unpredictability, which random processes have a similar role as a complexity generator in computer art (Kwastek, 2013). *Diligent Operator* mixes both strategies to make an unpredictable complexity in sound art. This project provides visitors with a chance to make the order of sound fragments as if they become musique concrète composers. In other words, connecting Ethernet cables in this project generates the chance order of diverse sounds. Mixing randomly amateurs' sounds from YouTube literally makes real time musique concrète via the Internet all the world over. In this regard, they are not passive conformists, but active musicians in interactive art.

The result of *Diligent Operator* is simple sound collages. The original sources from video clips are not manipulated except for trimming their length. Furthermore, its limited selections can make monotonous interactions. Even though *Diligent Operator* intends to encourage visitors to concentrate on sounds from diverse ordinary users, these could discourage them from actively taking part in making sound collages due to its restricted sounds intact. This would still be an unfinished project, and need some modifications to encourage visitors to actively participate.

Figure 6. The input part of *Diligent Operator* ©Respect Copyright

Future Development

Diligent Operator can be developed with the basic sound manipulation techniques of musique concrète. First, the collage music can be edited by modifying speed, envelop, direction, and volume in the original sound sources. These sound manipulations like DJing techniques are the main legacy of musique concrète. However, *Diligent Operator* does not intend to eradicate the original quality of sound because sound from amateurish videos in diverse cultures can contribute to breaking our filter bubbles, and give audiences authentic acousmatic sound experiences in a whole new world. The auditory environment from *Diligent Operator* will balance between original sound sources and their modified objects. In other words, this will be intertwined original sound with its manipulated sound just as in musique concrète. This complex editing method will revive a real musique concrète project, but as a real-time performance.

Next, this project can be more complex with more inputs. *Diligent Operator* uses only 12 Ethernet connections. For the future, it would incorporate around 100 inputs just as a real operator switchboard. This environment will provide visitors with more active participations to find "the random number." This will make participants real diligent operators.

Conclusion

Diligent Operator has the same origin, musique concrète, with Paik's *Random Access*. In this virtual environment for musique concrète, visitors become diligent switchboard operators as silent conformists. However, as interactive subjects, visitors can be active musical performers by composing the order of sound fragments with random algorithm based on their

---

[3] The reference for Random in Max/MSP Jitter describes that "A second argument is used to set a "seed" value for the random generator. If no argument is specified, the time value will be used to initialize the seed." Diligent Operator does not use a specific argument for the random object so that it generates a random number based on the time elapsed since system startup as the seed. In other words, six YouTube addresses among 32 ones are randomly selected and ordered for the list of sound clips by using this unpredictable seed when visitors connect the Ethernet cable. Visitors' reaction time will contribute to making a specific random order for playing the six video clips.

reaction moments. As opposed to normal interactive art, following the rule does not lead to a clear narrative result. Instead, visitors become collage musicians with unexpected daily life sounds. In this regard, *Diligent Operator* contributes to retrieving the active roles of both composers in musique concrète and participants in interactive art.

Acknowledgements

References

Godøy, R. I. (2009). Music Theory by Sonic Objects. In É. Gayou (Ed.), *Pierre Schaeffer Polychrome Portraits* (pp. 67-75). Paris: Institut national de l'audiovisuel.

Holmes, T. (2012). *Electronic and Experimental Music: Technology, Music, and Culture*. New York, NY: Routledge.

Kwastek, K. (2013). *Aesthetics of Interaction in Digital Art*. Cambridge, MA: The MIT Press.

Meigh-Andrews, C. (2006). *A History of Video Art: The De-velopment of Form and Function*. Oxford: Berg.

Paik, N. J. (1961). Après Serie/1: Focusing on Cologne. *Ongaku Geijutsu*, *19*(3), 13-17.

Paik, N. J. (1962, December). About the Exposition of Mu-sic. *De-coll/age, 3*, unpaged.

Paik, N. J. (1963). The Avant-garde Music in the World – Part II. Ongaku Geijutsu 21(12), 17-29.

Paik, N. J. (1973). The Paris Studio of Pierre Schaeffer and Musique Concrète. In J. Rosebush (Ed*.), Videa 'n' vide-ology, 1959-1973* (p. 83). Syracuse: The Everson Mu-seum of Art.

Paik, N. J. (1984). Time Collage. In S. Watari (Ed.), *Nam June Paik: Time Collage* (pp. 6-24). Tokyo: Isshi Press.

Paik, N. J., & Steinecke, W. (1999). Der Briefwechsel Nam June Paik - Wolfgang Steinecke 1957-1961. In H-K.

Metzger & R. Riehn (Eds.), *Darmstadt-Dokumente I: In-ternationale Ferienkurse für Neue Musik* (pp. 110-133). Munchen: Text+Kritik.

Pariser, E. (2011). *The Filter Bubble: What the Internet Is Hiding from You.* New York: The Penguin Press.

Paul, C. (2015). *Digital Art.* London; New York: Thames & Hudson.

Rennert, S. (2010). About Paik, with Paik: A Collage of Conversations Dating from 1992 to 2010. In S-K. Lee & S. Rennert (Eds.), *Nam June Paik* (pp. 213-217). Lon-don: Tate Publishing.

Russolo, L. (2011). The Art of Noises. In C. Kelly (Ed.), *Sound* (p. 22). Cambridge, MA: The MIT Press.

Schaeffer, P. (2004). Acousmatics. In C. Cox & D. Warner (Eds.), *Audio Culture: Readings in Modern Music* (pp. 76-81). New York, NY: Bloomsbury Publishing.

Schaeffer, P. (2012). *In Search of a Concrete Music* . (C. North & J. Dack, Trans.). Berkeley & Los Angeles, CA: University of California Press. (Original work published 1952)

Author Biography

Byeongwon Ha studied in the Film, Television and Multimedia department at SungKyunKwan University, Seoul, South Korea. After receiving his BFA, he created interactive media, experimental films, and video art in the graduate study of Media Art at Yonsei University, Seoul, South Korea. He earned an MFA degree in Digital Media from Rhode Island School of Design in Providence, RI, and won the thesis project award. Now he is writing a dissertation about Nam June Paik's interactive art in the Media, Art & Text Program at Virginia Commonwealth University in Richmond, VA. He participated in Art. CHI II workshop in CHI2016 in San Jose, California. He presented several papers about interactive art at the International Symposium on Electronic Arts (ISEA) 2014 in Dubai, 2015 in Vancouver, and 2016 in Hong Kong. He also exhibited an interactive piece in SIGGRAPH Asia 2012 in Singapore.