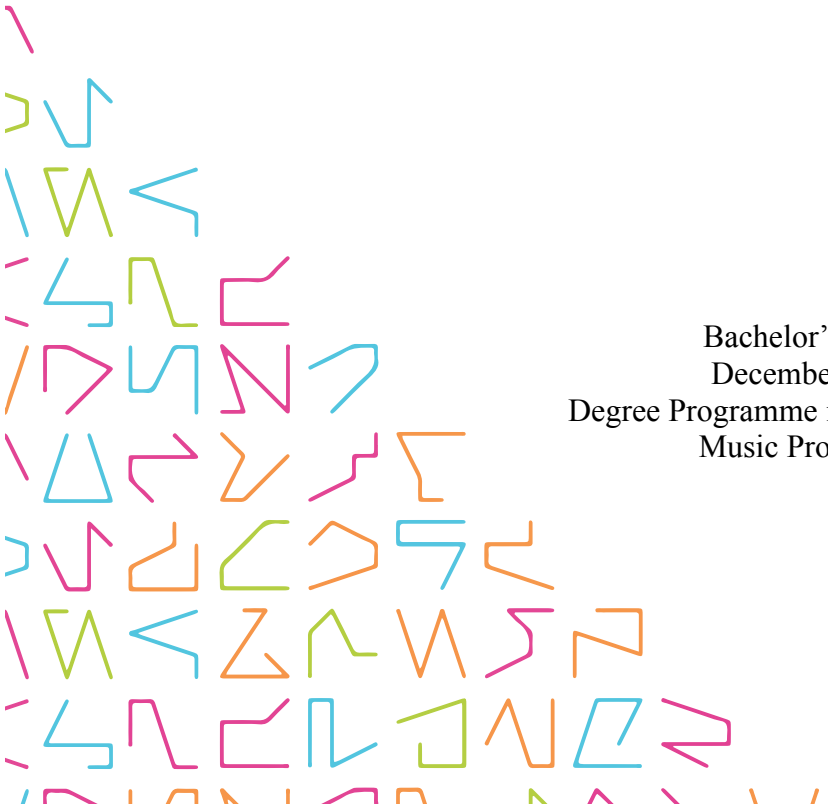
TAMPERE UNIVERSITY
OF APPLIED SCIENCES

PERFORMING MUSIC WITH MICROSOFT KINECT

Eemeli Sutelainen



Bachelor's thesis
December 2018
Degree Programme in Media and Arts
Music Production

ABSTRACT

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SUTELAINEN, EEMELI:
Performing Music with Microsoft Kinect

Bachelor's thesis 40 pages
December 2018

Recent technological inventions offer new possibilities for performing music. In this thesis, ways to control music by capturing motions with optical tracking devices are explored.

The purpose of the thesis was to find an optimal setup for creating virtual instruments that are controlled by the performer's bodily motions. In this case, Microsoft Kinect was chosen for the purpose. Other devices that use similar technology are also introduced shortly. In addition, the history of electronic music instruments and controllers is described and experimental approaches to performing music are presented.

Using Microsoft Kinect, Ableton Live and NI Mate, a wireless gesture controlled musical performance was created. The thesis describes the process and instructs how to set up the same system.

Key words: music performance, electronic music, motion capture, Microsoft Kinect.

ABRREVIATIONS AND TERMS

3D	Three-dimensional space
CV	Control voltage
DAW	Digital Audio Workstation, a music making software
Eurorack	Modular synthesizer format
Granular synthesizer	Sample based sound synthesis method, takes grains from imported audio sample and processes them into new sounds
MIDI	Musical Instrument Digital Interface, digital music data protocol
Motion capture	Technology that captures physical movements and transforms them into processable data
OSC	Open Sound Control, digital music data protocol
Skeletal data	Digital representation data of human skeleton
Synthesizer	Instrument that produces sound electronically
USB	Universal Serial Bus
Vocoder	Technology that processes human voice digitally

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1 INTRODUCTION

In recent years the development of technology has made many advanced technologies available for consumer usage. Live music performers have noticed the possibilities this opens for controlling music and so new tools for musical expression are emerging in fast phase.

The objective of this thesis is to examine Microsoft Kinect's suitability for live music performance situations. It provides instructions for an easily accomplishable motion capture music controller setup with the Kinect. The focus is in the musicality and flexibility of the setup.

The history of electronic musical controllers is covered and experiments with different approaches to electronic live performances are explored. Examples of other similar technologies will be compared with Microsoft Kinect and Kinect's history and operating principles are explicated. Different approaches to electronic musical performances will be discussed with examples of experimental music performers.

The practical part of the thesis consists of describing the following parts of the performance project: searching for optimal software, setting up the system and describing the details of the actual performance. The technological aspects are described in a detail but in a manner that the setup is possible to accomplish even with minor technical experience. This is to ensure the subject is approachable for all musicians and other possible users. Professionals from fields of dance and music were interviewed to form a wider picture of the subject and to get different point of views for the possibilities this setup offers.

This thesis is focusing mainly on technical details of given subject, so that the reader can use his/her imagination to invent his/her own ideas of how to use these technologies in real life and in their own projects.

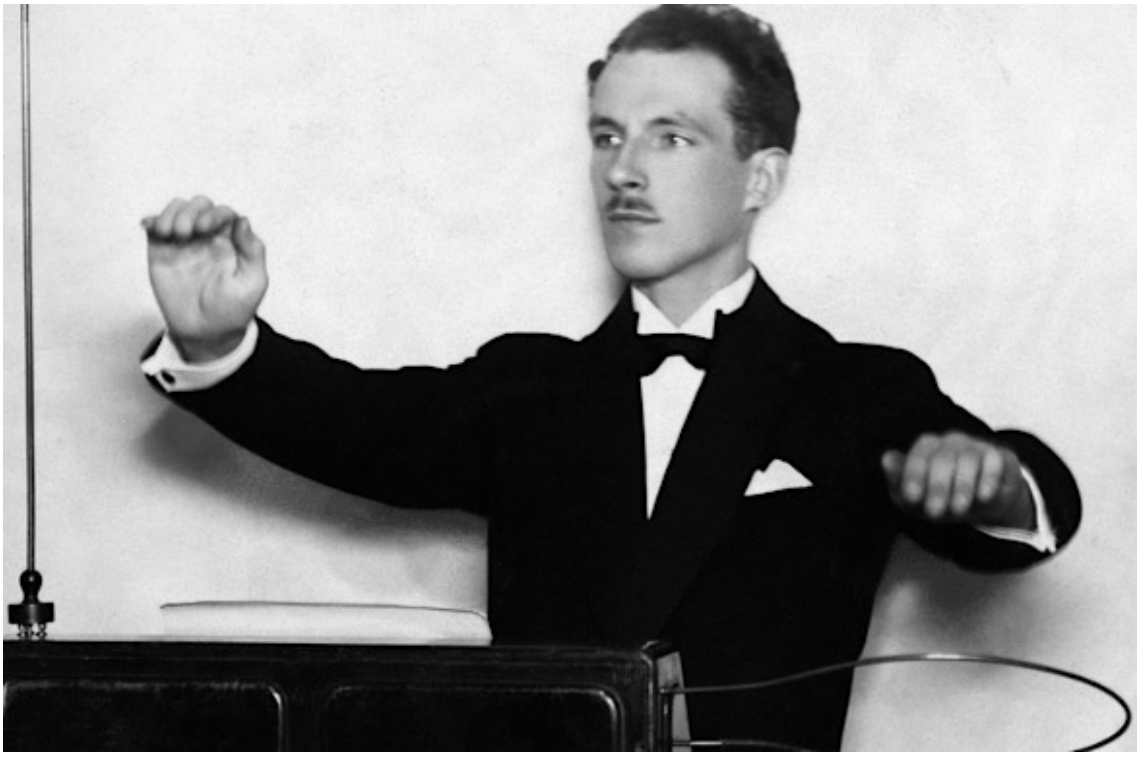
2 ELECTRONIC MUSICAL INSTRUMENTS AND CONTROLLERS

2.1 Early interfaces

When electricity was still in its earliest stages of experimentation and light pulp was not yet invented, some inventors were already working on how to use electricity in creation of sounds. Because of the lack of sound recording technologies, these early electronic instruments were designed solely for live performing. (Holmes 1985, 28.)

In 1895 Thaddeus Cahill submitted his first patent for his electronic musical instrument, the Telharmonium. It was heavily influenced by the "Musical Telegraph" invention, made by Elisha Gray, who was one of the inventors of the telephone and also by Hermann Helmholtz's writing 'On the Sensations of Tone'. In his text, Helmholtz introduced the ideology that reminds us of early additive synthesis, in which sound is created from fundamental tone and adding pure sine waves on top of it to create different timbres for musical sounds. The Telharmonium is considered to be the first significant electronic musical instrument. Cahill's agenda with this instrument was to build an instrument that produces perfect tones and is controlled mechanically with scientific certainty. Although the sound producing capabilities of Telharmonium were revolutionary (sound produced by tonewheels which are nowadays found for example in Hammond organs), the interface with its keyboard and stops was copied from pipe organs. (Crab 2016.)

Theremin is an analogue instrument invented by Leon Thermen (1896-1993) in 1922. It's operating principle was the heterodyning effect, in which two high frequency signals are added together to produce a third audible tone, which is the difference of the two high frequencies. The frequency of the audible oscillator is determined by the proximity of the musician's hand to the pitch antenna and thus it was the first instrument with non-physical control interface. Other features of Theremin were nearly pure sine wave sounds, a scale of five octaves and output signal that was continuous unless the hand was moved in and out the vicinity of the antenna (Holmes 1985, 44). Even Bolshevik leader Vladimir Lenin wanted to see the revolutionary instrument of the young inventor and invited him to a meeting to Kremlin (Vennard 2012). (Crab 2016.)



Picture 1. Leon Thermen playing his own instrument, Theremin (Eyck 2018).

Erkki Kurenniemi (1941-2017) was a Finnish electronic instrument designer, physicist and artist. In 1961 he voluntarily constructed an electronic music studio for the Helsinki University. The studio is the oldest one still in use in Scandinavia (Ojanen 2012). He designed and built many electronic instruments for musicians and composers for experimental music composition and performance purposes. The DIMI series (Digital Music Instrument, note the similarity with MIDI, Musical Instrument Digital Interface) consisted of several electronic musical instruments, combining analogue and early digital technologies that had experimental interface designs. DIMI-T was controlled by the EEG signal from user's earlobe. DIMI-S was multi-user instrument that tracked the electronic resistance between all players. DIMI-O or "Optical Organ" shares many similarities with Kinect as it synthesized music by reading a digitized video image. (Crab 2016.)

One of the most notable landmarks in electronic music history was the invention of voltage-controlled synthesizers. In around 1965 inventor Don Buchla (1937-2016) started to build synthesizers for composer Morton Subotnik. In 1963 another inventor, Robert Moog (1934-2005), was selling DIY Theremin kits to pay his bills. One of his customers was composer Herbert Deutch, who co-operated with him. Moog then began building his own synthesizer designs. Buchla and Moog both constructed their own sep-

arate synthesizer designs, starting with CV modular systems. This led to the bifurcation of two schools of thought; Buchla showing the way for the more experimental west coast way of thinking, and Moog for the efficiency, expediency and reliability oriented east coast approach (Rivas 2016). Buchla is also credited for inventing the step-based sequencer that opened up a whole new way to compose and perceive music. (Holmes 1985, 76–83.)

Picture 2. Optical organ aka Dimi-O by Erkki Kurenniemi (Kansallisgalleria 2003).

2.2 MIDI

In the analogue domain, making direct changes to the voltage flow controlled all the processes in electronic musical instruments. It was easy to link devices that had fairly similar operating principles. When digital devices came into market they, did not have such compatibleness.

Digital technology increased dramatically with the features and capability of electronic instruments. This caused the need for standard communication protocol in order for different digital musical devices to be synchronized. In 1983 Dave Smith and Roland

Corporation's Ikutaro Kakehashi introduced MIDI to general public in NAMM show. For their invention they were awarded 'Technical Grammy' in 2013. This created a new way to connect different the digital devices and instruments from different manufacturers such as; keyboards, samplers, computers and mixers to each other (Cancellaro 2005, 207). (Synthtopia 2012.)

Picture 3. Different hardware and software MIDI interfaces (Sutelainen 2018).

MIDI is not audio. It is information in the form of binary numbers, sent via cable or wirelessly from one device/software to another (Cancellaro 2005, 207). MIDI messages are used to control parameters in digitally controlled audio sources, such as the pitch or the velocity of the sound. Also some analog instruments, such as Roland Juno 106 have MIDI control features (Vintagesynth 2008).

MIDI is still widely popular and holds its place as one of the fundamental technologies in modern music production (Bateman 2012). Nevertheless it has its limitations. The range of MIDI messages is limited to 127 steps and there are also only 127 ports available for sending and receiving MIDI via one cable. This can cause problems when making subtle changes in music, as the step chances can be audible. Also, devices that send huge amounts of data at time can be problematic when using MIDI. For these purposes

OSC protocol would be recommended, as it enables more data flow and more precise tracking. (Niemeläinen 2018.)

2.3 Possibilities with modern technology

Every musical instrument utilizes the bodily motions into the favor of controlling the pitch, timbre and velocity. All acoustic and most of electronic instruments need to be physically touched to respond, typically by hands. With motion sensing input devices, musicians are able to construct instruments that work without physical connection to sound source. Computer generated music has, in many cases, shown the way for digital technologies and for the concepts of interactivity (Paul 2003, 132-133). Combining interactive devices with the capabilities of modern digital computers has made it possible to make customized instruments for the specific needs of each musician.

This makes it possible for musicians to free themselves from fixed instruments and explore the unlimited range of bodily movements and postures. This offers ways to explore new combinations with the interplay between physical reality and music. Musician and composer Ilkka Niemeläinen is developing wireless systems that recognize different signs drawn in air by hand and transforms them into digital messages that can be used in variable message sending and controlling purposes (Niemeläinen 2018). The limitations of these setups come from the quality of the chosen gear, although there is great freedom in the possibility for mapping any signal to any parameter.

Too wide range of possibilities might be seen as a curse too. Research mentioned in Andrew Hugill's book "The Digital Musician" shows that musicians lacking in substance, no legacy or continuation and lacking social conventions are the downsides of digital instruments (Hugill 2012, 67). As the sound always comes from a physical source the musician playing with wireless controllers might have feelings of a disembodied experience (Hugill 2012, 67). In this sense, technology offers more freedom than traditional instruments, although too much freedom can be a limitation in itself in some situations. Niemeläinen had noticed this too, and emphasized that the focus should be on the substance and meaning in performances and music making, not on the technological details (Niemeläinen 2018). Social interactions, aesthetic dimensions and cultural connectivity must be taken in to account to avoid producing a mere technical presen-

tation of used technologies of choice. As philosopher Theodor W. Adorno stated, “the work of art without content, the epitome of a mere sensuous presence, would be nothing more than a slice of empirical reality, the opposite of which would be a work of art consisting of mere rationality devoid of all enchantment” (Adorno 1978, 197).

3 UNCONVENTIONAL CONTROLLERS IN LIVE USE

3.1 Motion tracking technologies

Musicians have shown growing interest on wireless musical controlling in recent years. With digital technology the musician is able to create a custom instrument that suits his/her specific needs (Hugill 2012, 138). Many have developed their own systems in hardware and/or software domain to attain the best solution for their own ways of musical expression.

Onyx Ashanti is a musician, programmer and 3D print-designer who has developed multi dimensional musical controllers called 'Beat Jazz'. He first introduced them in TED-talk in 2011 and has been developing them further ever since. Ashanti uses custom software to capture the data from his controllers and has integrated 3D modelling and printing into the controller designing. Since 2013 he has been developing software for a system that is fractal, which means that each thing that is added then evolves. In his website Ashanti gives tips about how to design one's own 3D printed controllers. (Ashanti.)

Picture 4. Onyx Ashanti with his Beat Jazz controllers (Ashanti).

Grammy winning artist Imogen Heap has developed her own musical apparatus called Mi.Mu gloves. The project started as her own experiment and later on developed into a

diverse team of engineers, artists and designers who specialize in textiles, electronics, sensors, software and music. As the name suggest, they are lightweight musical controllers in the form of wearable gloves, containing bend sensors that capture the physical motions of fingers. The company tries to get the gestural musical performing in the hands of as many people as possible. The gloves are still not available for consumer market, but the company has made collaboration with other professionals in music, for example pop star Ariana Grande has used the gloves in her live performances. (Mi.Mu.)

Picture 5. Artist Imogen Heap with her invention, Mi.Mu Gloves (Crowley 2012).

Karlax is multi dimensional digital controller for digital arts developed by De Fact Company. It is wireless and is physically similar to a wind instrument. It is long, flat cylindrical shape and has keys for every finger. It operates in a way that the movement of fingers, wrists, elbows, forearms, torso and whole body are captured, measured and transmitted to the program that then runs the artistic intentions of the performer and/or composer. Karlax is said to be an immersively responsive and high quality instrument, but with its ~4000€ price tag it is still too costly for many potential buyers. (Karlax 2011.)

3.2 Other experimental approaches

In 1965 Alvin Lucier conducted a performance called “Music For Solo Performer”. It is considered to be the first musical performance where brain waves were used to directly generate the resultant sound. For the performance, Lucier sat in middle of a space surrounded by timpani, gongs, bass and snare drums and cymbals that were triggered by alpha waves from his brain, captured by electrodes attached to his head. There is also a Eurorack module called BI1 Brain Interface that uses EEG-kit to transform brain waves into CV. As a result, it is the first commercially available brainwave to synthesizer interface. (Sound machines 2014; Dewar 2017.)

Artists and musicians have been experimenting with using biosensors in creative purposes. Biosensors are devices that detect the presence or concentration of organic material, such as a biomolecule, a biological structure or a microorganism (Nature.com). For example, the sensors can be attached for to plants and other organic materials to obtain data for controlling electric devices. In 1970 bio-art pioneer Richard Lowenberg cooperated with artists Woody and Steina Vasulka to explore the creative possibilities of the EEG biofeedback system. The system was built with help from Peter Crown, Ph.D. of physiological psychiatry. These experiments were then presented in the legendary venue ‘The Kitchen’ in New York. In the mid 70’s Richard Lowenberg also collaborated with several artists and scientists to create art and music with technology of multichannel bio-telemetry devices and remote sensing systems, wind-tunnel and multispectral imaging experiments, CTS satellite communication and gravitational simulation. (Data Garden 2011.)

Advanced touch based systems can also be noted as experimental control devices. Touch screens have widened the possibilities of music making and performing as there is huge selection of musical applications for tablets and smartphones. Nuno N. Correia has pointed out the interactivity of these technologies in his book “Interactive Audiovisual Objects” by saying that “a particular kind of app has appeared – a “music box” type of artistic app, a playful alternative to the linear, passive music listening experience” (Correia, 2013). A good example of touch-based device, developed strictly for musical purposes, is Roli controllers, that have interfaces that are similar to a classic keyboard appearance, but have soft, gel-like surface made of silicone (Roli 2018). Mu-

sician and composer Amon Tobin uses Continuum controllers in his production that have keyboard-like interface but have also a soft surface (Tobin 2014, 2:40). Both of these devices can detect finger pressure variations and track finger positions between keys and in lengthwise direction, so that the user is not restricted only to typical limitations of a keyboard instrument.

Picture 6. Brainwave and plant music from The Secret Life of Plants, 1976 (Data Garden 2011).

3.3 Dance controlling music

The idea of transforming dance to music is nothing new. For example Erkki Kurenniemi made collaborations with dancers with his DIMI-series. Leon Theremen also invented an electronic instrument called “Terpsitone” to be controlled by the body of a dancer. All motion tracking devices and other technologies that track physical movements of human body can be used in interaction with dance. (Crab 2016.)

Musician Zora Jones has collaborated with Sinjin Hawke under the name “Fractal Fantasy”. The artists have made together many multimedia art and music projects. In their live shows they have used Microsoft Kinect to create live art performances where visuals and music are both controlled by the movements of the artists’ bodies. In their per-

formances they use dance-like motions (YouTube 2018). These are then transmitted to musical and visual programs that respond to the bodily movements. (Wilson 2018.)

Classical music composer Richard Wagner had a creative dream of concept called “gesamtkunstwerk” which translates to “total work of art”, in which visual art, drama and music are combined together (Wagner 1849). For example, visual artist Ville Niemi and choreographer Maikki Palm conducted a form of multimedia artwork called “The Ground Is Lava” which is similar to the concept, as it combined visual arts, dance and music. Niemi coded an application in ‘openFrameworks/C++’ that processed data from Kinect, which could be used to interact with the visuals. Musician Viktor Toikkanen composed interactive music for the project, in which he used modular synthesizers that reacted to movement data of the dancers’ bodies, captured by the Kinect. (Niemi 2017.)

Picture 7. The Ground Is Lava performance, dancers in interaction with visuals and music (Saarinen 2017).

Choreographer and dance teacher Riikka Korpi speculated that these new technologies are gaining more and more attention in dance circles. Young and inventive people want to explore the new possibilities these technologies offer for dance and gesture expression. Professionals of more conventional dance genres might be slower to respond to these possibilities, however modern dance and street dance artists and choreographers

will want to take them under their experimentation. Korpi mentioned that African music has the kind of interplay between dancer and musician where both respond to each other's output. Korpi noted that she would use motion capture technologies in improvisatory purposes to create dance works that focus on the motion and gestural expression. Also, dance teaching could benefit from this technology, as it would offer students new experiences. This interactivity is the next step from musician who reacts to dancer's moves to musical machine that directly responds to the movements of a dancers physical body. (Korpi 2018.)

4 MICROSOFT KINECT

4.1 Information and History

Microsoft Corporation is one of the biggest companies in the world (Statista 2018). Bill Gates and Paul Allen founded it in 1975 and the company has been one of the leading names in the field of technology ever since. Over the years, Microsoft has developed many popular services and devices such as Windows-series operating systems and Xbox gaming consoles. (Microsoft 2018.)

Microsoft Kinect is a sensory device that contains a depth sensor, a colour camera and four microphones and it provides full 3D body motion capture, facial recognition and voice recognition capabilities (Zhang 2012). Kinect was developed under the name 'Project Natal' to be Xbox's console controller, first announced in 1.6.2009 at an E3 event (Clayman 2010). When it came out, for a short a time, it was the fastest selling electronic consumer device in history (BBC 2011). Kinect offered an exciting new way to control games, explaining why media and consumers got so intensively interested.

Although Kinect was intended to be purely a gaming controller, some curious people wanted to try its suitability for entirely different purposes. Hackers were intensively interested in pushing Kinect's limits. A company called 'Adafruit Industries', that produces DIY electronic kits, announced on the day of the launch of Kinect, that it would give $1000 for the person who first gets the Kinect running on Windows or any other operating system (Giles 2010). Since then the Kinect has been used in a wide range of different purposes and 'OpenKinect' community offers help and guide the developing new applications for Kinect on different platforms (OpenKinect 2012). Nowadays Windows provides developers with the necessary software called 'Kinect for Windows Software Development Kit' (SDK) for the creation of new applications for the Kinect (Microsoft 2018).

At the moment the production of Microsoft Kinect is discontinued. It is likely that other similar optical devices will take Kinect's place as most widely used consumer priced motion capture camera (Corden 2018). Even Microsoft itself encourages people to

move their attention to other sensory devices such as Intel RealSense cameras (see the following chapter) (Microsoft 2018).

Picture 8. Microsoft Kinect, model 1414 (Sutelainen 2018).

4.2 Comparison with other similar devices

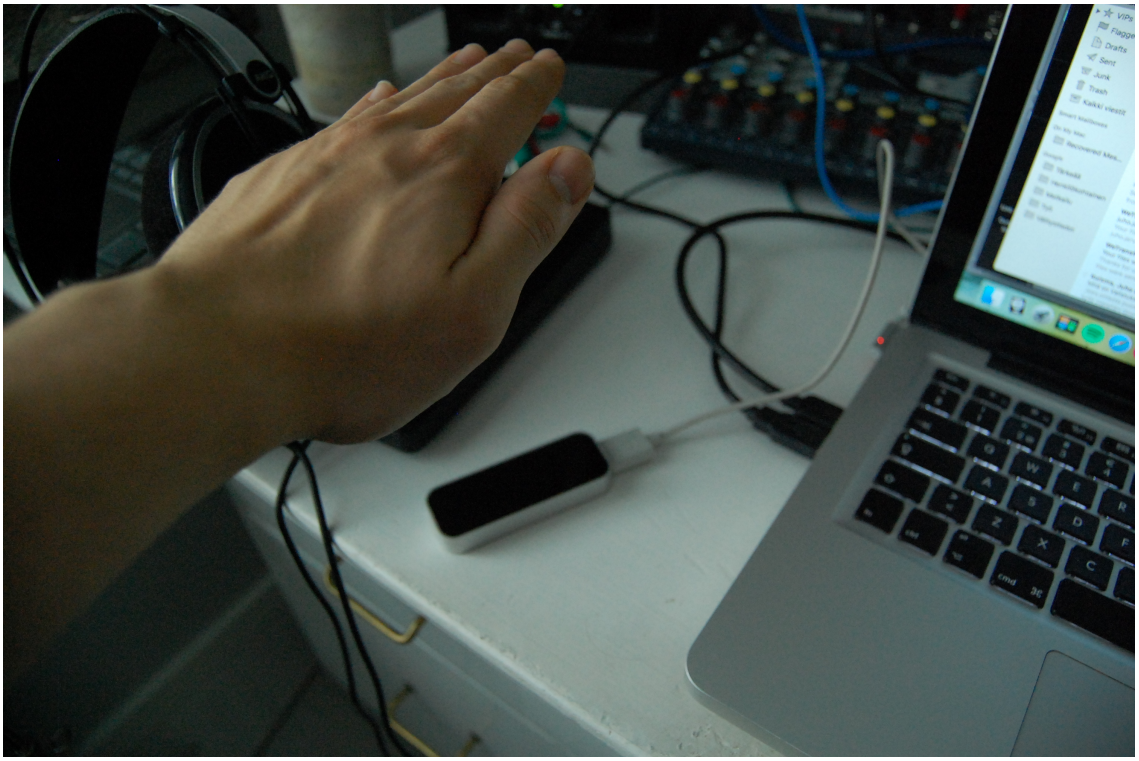
In addition to Microsoft Kinect, there are multiple devices that offer similar approaches to wireless, gestural and body motion music control. For example Leap Motion Inc., founded by Michael Buckwald and David Holz in 2010, manufactures optical sensory devices that track hand and finger movements. The Leap Motion camera is smaller physically and has a narrower tracking area than what the Kinect has. It is also possible to attach a Leap Motion device to VR-kits in order to develop software for hand tracking, to control virtual reality applications. (Leap Motion 2018.)

Intel® RealSense™ Depth Cameras are 3D depth perception devices like the Microsoft Kinect. Some models support even outdoor usage. RealSense Cameras have multiple functions available, such as; hand tracking, facial recognition, 3D scanning, speech recognition, using fingers as a cursor to substitute the conventional mouse and in many

more (Blacker 2016). They come in different developer packages and are available via Intel's web store. (Intel.)

Holonic Systems is a company based on Helsinki and Brussels. They have developed iOS application called "Holon" that can be linked to 'Apple Watches' and Suunto's 'Movesense' sensors to control a synthesis engine by the user's biomechanical movements and biosignals. (Holonic Systems 2018.)

Because of the discontinuation of the production, it is possible to buy only used Kinects. This can cause risks in professional projects, as it is impossible to know how the former owner has dealt with the device. Because there are multiple Kinect models it has to be taken into consideration which model works with what software. Nevertheless, Kinect is a high quality device with reasonable price tag that offers a flexible and reliable solution for motion tracking purposes.



Picture 9. Leap Motion Controller (Sutelainen 2018).

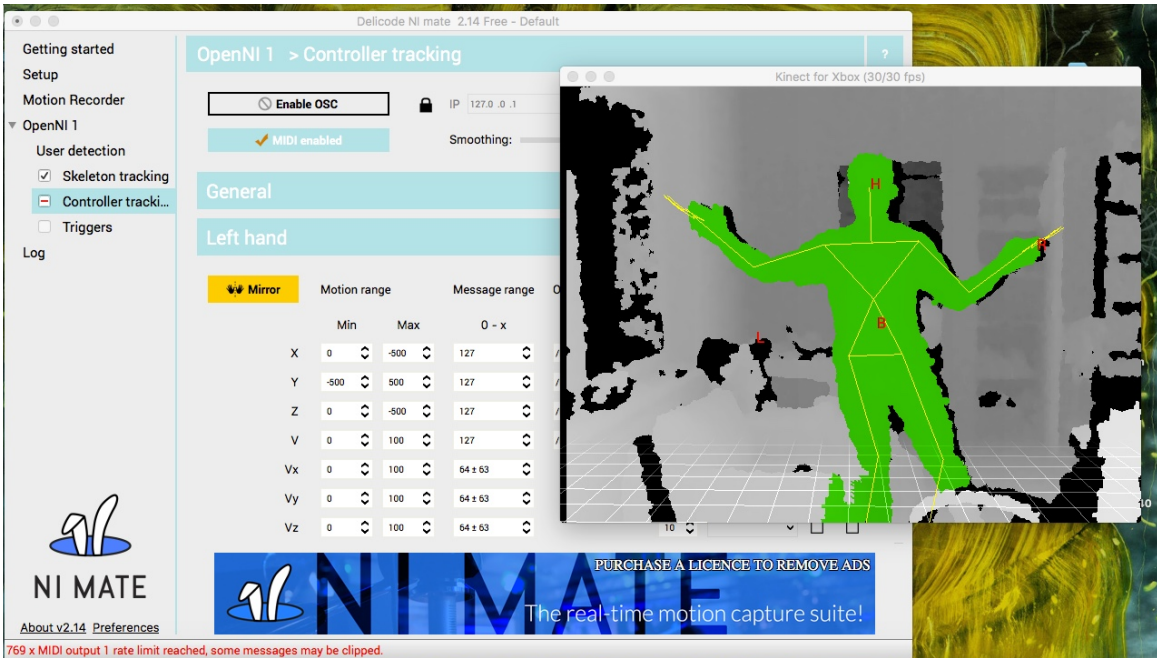
4.3 Selection of suitable software solutions

As mentioned earlier Kinect was not originally designed to be used with Windows, OSX or any operating system other than Xbox devices. All the software solutions available to use Kinect in other purposes are entirely made by third party developers. Some are little scale hobbyist projects that can be challenging to install but can serve more experimental purposes, whereas the more professionally produced programs offer stability and wider scale of features. My intention was to find an application that would make the Kinect work as a direct MIDI controller.

Kinectar is free MIDI-Kinect interface. It works as skeletal to MIDI data transformer. To work properly it needs input from skeleton tracker software, either from Synapse or OSCeleton. For me it was not possible to get it working, due to Synapse's incompatibility with newer Macintosh Operating Systems. At the moment Kinectar is discontinued so it no longer gets software updates. (Ethnotekh.)

Synapse offers its own 'Max For Live' patches. These are plugins for Ableton Live that are created with MAX/MSP/Jitter programming language. There are many patches for different purposes available: simple joint position, to Live control patch; a patch where moving a joint quickly triggers an event in Ableton and so on. The problem arises again with the incompatibility of Synapse and newer versions of Mac OS. (Synapse.)

The application I decided to use is NI Mate from Finnish company called Delicode. It is an easy to use cross-platform, cross-sensor real-time motion capture suite. It operates as a connector between physical sensory devices and computer software. The data from suitable devices can be transformed into MIDI and OSC data. There is free version to download having all the essential features, but lacks the possibility to save settings. The pro licence unlocks some extra features, for example the possibility to create multiple dimensional control layers. The application also supports other devices than the Kinect, for example Intel RealSense cameras and Leap Motion devices. (Delicode 2018.)



Picture 10. NI Mate. (Sutelainen 2018)

4.4 Connecting Kinect to a DAW via NI Mate

The following instructions are for Mac users only.

Kinect is connected to Mac via USB-port. To connect NI mate to DAW of choice, the user has to open; Audio MIDI setup>Window>show MIDI studio and then double-click the IAC Driver icon and check the option "Device is online" in order to activate it. After this, IAC-driver should be visible in MIDI input and output sections.

NI Mate should detect the Kinect controller automatically if it is correctly connected. NI Mate is accessed from the upward toolbar icon in the Mac OS. When the camera is active, go to Control Interface>Open NI1>Controller tracking and activate it from the button next to it. Then click the “Enable MIDI” button to activate MIDI output. Then the correct MIDI output port should be activated from Preferences>MIDI output. By activating it and then selecting the IAC driver from the Port section one should have everything ready for sending the MIDI data for Ableton.

In Abelton Live one has to make sure that the IAC Driver is active to enable the MIDI data input. This can be done by going to Preferences>Link MIDI and checking the

Track button for IAC Driver is on “On” mode (Robinson 15, 2014). After these steps Kinect should be ready for MIDI mapping.

4.4.1 MIDI mapping the Kinect

The process of assigning physical MIDI controller that contains hardware faders, slider, knobs, wheel, buttons, pads keys, etc. to various controls and parameters is called MIDI Mapping (Robinson 402, 2014). In this case, motions of human body substitute the physical adjustors. In this part of the process, one has to have something to control with the MIDI data. This can be any Ableton’s own plugin instrument or effect or some third party plugin of users own choice. Note that not all parameters in all plugins are available for MIDI-mapping.

Ableton’s MIDI mapping window is opened by going to Options>Edit MIDI map, clicking ‘*MIDI Map Mode switch’* located on the upper right corner of the main Live screen or by using shortcut ⌘ + M (Robinson 2014, 402)**.** If NI Mate is active and detecting skeletal data from Kinect and all the preceding steps have been made correctly there should be data flowing to Ableton. This can be seen from the upper left window in Ableton’s MIDI mapping view. Now the problem is getting only one vector sending data at a time from NI Mate to correctly map everything in Ableton.

To send only one MIDI CC-message at time from NI Mate, the user has to use the solo function. Each vector has to be soloed separately in order for Ableton to recognize single MIDI CC messages so that they can be precisely mapped to right parameters. When vector is soloed in NI Mate it shows activity in Ableton’s MIDI mapping view. Then the desired parameter is clicked and the connection between all functioning components in the system should be linked together and ready for action.

4.4.2 Example: Controlling Granular Synthesizer with Kinect

Kinect offers intuitive and playful way to control musical software. Granular synthesizers have several different parameters available for modulation. In my opinion it was a

really good match with how the Kinect works as controller. I will now demonstrate and describe how I used these two together.

Granular synthesis is a digital sound producing method that uses audio files as their sound source material and chops them into little pieces called grains, to generate new sounds. These grains can be altered in length, grain rate, pan, volume and many more. This technique is fairly new in general music production usage but can also be seen as a reflection of long-standing ideas about the nature of sound. Studies in quantum physics have shown that sound can be atomically reduced to physical particles. These new ideas and ways to perceive music led to invention of granular synthesis through the works of Iannis Xenakis, Curtis Roads, and Barry Truax. (Opie.)

There are many granular synth software and hardware in the market, all having their own strengths and special features. My choice was to use a software synth called “The Mangle” by Sound Guru (Sound Guru 2015). It has many parameters that can be modulated via MIDI that I was already familiar with, so it was perfect for the desired purpose.

Picture 11. The Mangle, Ableton Live and NI Mate working together (Sutelainen 2018).

The parameters I found out to be most intuitive for control via motion capture technique were grain rate (the time between individual grains), grain position (the position of the cursor which defines the section of the audio file from where the grain is launched),

grain length parameters (attack, sustain, release) and low pass filter cutoff. By mapping these individual parameters to different hand movement vectors (x, y, z) I was able to create instruments that were performative. By saving all the settings, the user is able to get entirely different sounds by importing different audio samples into the granular synth.

5 PERFORMING WITH KINECT

5.1 Performance

The performance was held on 17th of November 2018 in Gallery Rajatila. The performance was called “Hiljaiset Liikkeet” (translates to “Quiet Motions”) and its length was 15 minutes. I organized the event with co-operation of Rajataide Ry and the other act of the event, fellow performer Danielė Gavėnaitė.

I experienced with various software and devices to find the most optimal setup for my live performing purposes. My characteristic musical style is ambient music, that does not have clear pulse in it, so I was looking for setup that enables free and flowing musical expression. In my experiments I became fond of processing my voice in various ways and controlling these vocal sounds with Kinect. I used a headset microphone for the purpose so my hands were free to use the Kinect.

For the software side of my setup I used Ableton Live’s own plugins and plugins form third party manufacturers. The vocal processing was made mainly with Ableton’s vocoder effect and grain delay (granular delay effect) and many of the sounds controlled with the Kinect came from the Mangle granular synthesizer (see chapter 4.2.2). In NI Mate I focused on using the hand vector parameter functions because it suited the slow phased and improvisational style of the music. I experimented with the trigger function in NI Mate, however, at best in my experimentations; it created glitches in Ableton, resulting in a loss of utility for this function in my project.

5.1.1 Frame of Reference and Preparations

In electronic music performances, the common problem is that the audience does not always know what the performer actually creates with his/her live setup. The common misconception is that members of the audience believe that the artist is pressing ‘play button’ and does not actively interact with the music. The performance should therefore be conducted in a way that the audience can keep track of what the performer’s role is in the relation to the sounds produced (Lew 2004, 146, according to Correia 2013). This

adds an extra challenge for the electronic music performer, to keep the focus in the sounds that are in his/her control and to make it clear to the audience which movement controls what sound. Simultaneously the performer should make the performance as musically pleasant and enjoyable as possible in its entirety. Having these facts in mind the Kinect offers a more performative and intuitive musical expression possibilities that the usual knob and slider MIDI interfaces do.

Musically I got inspiration from the works of Arca, Actress and Vladislav Delay to name a few. I wanted the music to be subtle in its mood but to have enough details so that the listener could explore different layers of music during the performance. Lyrics were written in a manner that they were abstract enough to give space for the musical content maintain the leading role.

5.1.2 Creating the Performance Project in Ableton Live

Right from the beginning I was interested in using the Kinect to control granular synth and audio effect parameters. Also, voice processing had many possibilities I wanted to test in practice. I created instrument racks in Ableton that had various different granular and vocal processing instruments/plugins in them, and experimented with mapping the MIDI data from the Kinect, in order to create different virtual instruments where different parameters were controlled.

Ableton Live's clip view enables the user to easily sketch musical ideas and effortlessly experiment with different combinations of sounds to creatively produce soundscapes and motifs. I used this view in the beginning of the project to form the core for the performance. I came up with three different virtual instruments and constructed the songs around the moods and harmonies they created. First "instrument" was my voice, ran through grain delay and reverb effects, the Kinect controlling multiple parameters of them (especially altering the "pitch" parameter in pitch delay made immersive and distinct changes to the sounds created). The second one was the granular synth "The Mangle", with a piano sample imported into it. This instrument was constructed with the idea of making harmonic changes by moving the left hand in a horizontal direction and the right hand controlling the dynamic content of the sound (something similar to the operation principle of Theremin). The third instrument was also 'The Mangle' but this

time the sample was not melodic, instead it was inharmonic by its nature: a long audio sample of chimes. In this one I decided to control the pitch, the grain rate, the grain position and the length of the grains. This then was processed with delays and vocoder and in the very ending a resonator effect, which added harmonic content to it.

The final version of the performance project was arranged in the linear view in Ableton. Linear view is the typical view of any Digital Audio Workstation that has a vertical timeline for playbacking MIDI and audio tracks. This made it possible to make a clear time frame for the performance. I composed three separate pieces of music and automated different tracks in a manner that allowed space for improvisation. Between the songs there was space for playing the virtual instruments completely solo, so that the audience would get better picture of how the body motions affect the music.

5.1.3 Performing Live

The performance was held in a gallery space. The acoustics of the space were a little problematic due to the wide, empty space with hard surfaces. These surfaces created a lot of natural reverb. Because of this, I decided to decrease the amount of digital reverberation in the tracks as compensation. Also, the audience dampened the acoustic properties of the gallery enough that the music remained detailed during the performance. The cable from the laptop to the Kinect was shorter than I expected so it limited to the space in which I was performing. This could have been easily fixed by organizing the devices in a different manner.

The Ableton project was pre-arranged in a way that there was still space for improvisation. I did not make choreography, so I was mostly improvising with the virtual Kinect instruments. The first two songs had lyrics and a clear structure with pre-made tracks in them. In these songs I sang through the Kinect controlled effects to emphasize certain parts of the lyrics and to improvise melodies by singing and whistling through them. The third “song” was totally free from any form. Only ‘The Mangle’ instrument was used for improvisation. With it I was able to create tensions between total silence and melodies created by using the Kinect and my own voice processed with vocoder. The last song was an improvisation with the third pre-constructed Kinect instrument on top of a rhythmical song. The outro of the performance was played solo with this same in-

strument. with the resonator effect giving a little extra edge to create a climax to the performance.

Picture 12. The performance situation (Töyrylä 2018).

5.2 Notions

Kinect works well with NI Mate in performance situations. One unfortunate downside is that it tends to lag when the performer moves fast and the skeletal tracking can get stuck from time to time. It is possible to compensate these unwanted errors by adjusting the "soothing" feature in NI Mate, which makes it respond to the movements in a smoother way. Niemeläinen noted that Kinect works better in improvisatory musical purposes than in playing exact melodies and I agree with him in this manner (Niemeläinen 2018).

All kinds of creative combinations in choosing the controllable parameters can be explored. Kinect can control selectively, part of the audible material or all of it. Real instruments or singing can be live-processed through an effect that the Kinect controls. The Kinect performer can act as a virtual conductor and control massive ensembles of musical parameters at time or be more like a virtual instrumentalist and concentrate on just one virtual instrument at time.

Toni Honkala and Elmeri Pörsti had both used Kinect in their in studies when they had their final performance presentations in Tampere Conservatory. They both collaborated with dancers so they had had experience of interactive and creative usage of the Kinect and had also used the same software, NI Mate. Pörsti had noticed that two dancers could control Kinect facing it back-to-back, forming fourhanded skeletal figures. In their performances they utilised mostly the trigger functions, as they had noticed it fitted well for working with dancers. The use of triggers was not as limiting for the dancers to express their motions, compared to the tracking of every single movement of the arms would have been. (Honkala 2018; Pörsti 2018.)

Niemeläinen mentioned that most technical problems concerning optical motion tracking input devices in performance usage are related to software limitations and development, not to the physical devices them selves. Responsiveness and playability can and must be further studied and developed by focusing on the coding and logic behind the systems. He also pointed out that outdoor environments are problematic if direct sunlight points at the venue as these technologies work better on dimmer lightning. (Niemeläinen, 2018.)

6 CONCLUSIONS

With Kinect, NI Mate and Ableton the user is able to compound a working interface to use one's body for musical controlling purposes. This setup offers great freedom for musicians and other users to explore human body's capabilities as direct musical controller.

I think that these technologies will attract more and more people who want to explore new possibilities of music expression. The technology is not as expensive anymore enabling more individuals to purchase it. As Niemeläinen mentioned, the software side of the optical tracking devices has to be further developed to utilise it more fluently for music usage. There are only modest amount of available solutions and they are still in the early stages of development, making the technology not so widely know in general. With modest effort in developing the software to suit music related purposes, the motion tracking music making could be offered for wider consumer markets.

Other domains that could possibly use the Kinect and other optical tracking devices in musical purposes would be: music therapy, interactive art installations and music composing. One interesting notion is that even people who cannot use their fingers, for one reason or another, to play physical instruments, could still create music by interaction with these kinetic virtual instruments. The Kinect's interactivity works well even with users who have no former background in music or performing. The intuitiveness and playability play a major role in how the Kinect works, so it is an easy to approach device that offers new ways for artistic performing.

To get more out of Kinect as musical controller one has to dig deeper into researching the technology of optical tracking cameras and to develop his/her own software for it. With NI Mate the user don't have the access to the raw sensory data from Kinect. This sensory data could be used to develop applications that have more sophisticated and diverse features and even to build virtual instruments that are crafted to suit the needs of individual projects or performances. This software development can be done for example by using MAX/Msp or Processing coding languages.

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APPENDICES

Appendix 1. Ilkka Niemeläinen interview

Interviewer: Eemeli Sutelainen
Interviewee: Ilkka Niemeläinen
Helsinki, 28.9.2018
Transcription based on a recording of the interview
Length of the recorded interview: 1:27:45

1:04 Kun ne kehitteli sitä NI Matea, silloin tehtiin yhteistyötä tämän Kinectin ohjauspään kanssa ja silloin siihen rakennettiin se OSC ja MIDI järjestelmä vaihtoehdot.

1:40 Se oli jo ihan hyvin rakennettu se träkkäys-pää (NI Mate/Kinect yhdistelmässä). Että se oli jo aika skarppi aika hyvissä ajoin. Enemmän mietittiin että mitä kaikkea sieltä pitäisi saada ulos ja mitä se vaatisi sinne MIDI päähän.

8:43 Me tehtiin silloin sen Tutkivan teatterityön keskuksen projektin yhteydessä sellainen testi demo näyttelijän kanssa, tämmönen pantomiimikko, jossa testattiin vielä vähän skarpimmin niitä toimintoja ja vähän tutkittiin muistaakseni jo siinä vaiheessa näitä hahmoasioita että pystyskö esimerkiksi tekemään ympyröitä tai jotain tiettyjä liikkeitä joilla voisi saada lisämerkityksiä. Että jos teen pääasiassa tällaista liikettä niin se tarkoittaa jotain.

14:04 Sen (Kinect) funktio ei ole niinkään se että sä pystyt eksaktisti toistamaan tietyn sävelkulun. Vaan pikemminkin se että rakennetaan sellainen niin kuin improvisaatioympäristö että sulla on tietyt asteikot ja systeemit käytössä, joilla sä voit improvisoida. Sitten se improvisaatio on enemmänkin sellaista kokeilua ja sitten sen mukaan liikkumista kuin niin että pyrit soittamaan eksaktisti melodioita johonkin tiettyyn systeemiin. Siihen se taipuu mun mielestä aika huonosti.

17:05 Se painopiste on siellä käytettävyyden ja ohjelmoinnin päässä joka on se vaativin osa tästä.

20:55 Sitten jos alkaa ajamaan isompia määriä dataa niin sitten se OSC on fiksumpi ratkaisu. MIDI kyllä taipuu just tuollaiseen vähän kevyempään ohjaukseen että sieltä ei tule ihan hirveästi möyhöä. MIDI alkaa jossain vaiheessa menemään tukkoon. Ja se työntää aika tiukasti se Kinect sitä tavaraa.

35:18 Niihin pitäisi oikein panostaa siihen käyttöliittymään että siitä tulisi selkeä ja että se ei vaadi näin paksua ohjekirjaa että siitä saa jotain tolkkua. Kyllähän se tavoitteena on näissä hankkeissa.

41.30 Jotenkin tämä (Leap Motion) kun se on rajattu pienemmälle alueelle niin se tuo mukanaan sellaista skarppiutta. Ja ehkä just se että kun sen ei tarvitse träckätä koko kehoa niin se pysyy jotenkin paremmin kyydissä. Että kun se seuraa vaan käyttäjän sormia. Sen sijaan että se tutkisi kaikkia raajoja jatkuvasti.

51:00 Siinä kun on nämä tällaiset USB-tyyppiset liittimet niin nehän eivät ole mitään kauhean järeitä. Jos alkaa keikoilla revaamaan niin kannattaa ottaa huomioon. Mutta muuten se on kyllä toiminut. Ainoa noissa infrapunajärjestelmissä on se että esimerkiksi ulkovalaistuksessa ne ei tahdo toimia. Tai jos on todella kirkkaat valot jotka sohottaa suoraan. Ne tykkää enemmän tuollaisista pimeistä keinovalo-olosuhteista.

56:00 Tämä kuitenkin kulminoituu sitten loppupeleissä siihen että varsinkin nyt kun näitä antureita ja erilaisia järjestelmiä on valmiina tarjolla niin se on nimenomaan se logiikka, se miten ja mihin sä käytät sitä tietoa. Se että sitä tietoa saa nyt kyllä hyvin kaikista jutuista mutta se että mihin sitä käytetään, mihin tarkoitukseen. Se ydinkysymys nyt edelleen tässä että sitten kun sä teet sun musiikkia tai mihin ikinä niitä käytätkin niin sen sisällön suhde tavallaan siihen teknologiaan on kuitenkin se ratkaiseva. Ja se on se työläin osa…

Appendix 2. Riikka Korpi interview.

Interviewer: Eemeli Sutelainen
Interviewee: Riikka Korpi
Tampere, 7.11.2018
Transcription based on a recording of the interview
Length of the recorded interview: 24:38

3:14 Mitä enemmän (interaktiivisen teknologian hyödyntämistä tanssissa) tuollaisilla livekeikoilla ja tuommoisilla niin varmaan rupeaa tulemaan mutta että suurin osa minkä kanssa tanssijat tai koreografit tekee töitä on niin sanottua perinteistä, elikkä sä teet musiikkiteatteria tai musikaalia tai ylipäätään tällaisia perinteisiä tanssijuttuja mutta että ihan varmana katutanssi ja nykytanssi rupeaa hyödyntämään tätä. Ne taas perustuu enemmän tällaiseen uuteen, että luodaan tyhjästä uutta.

5:06 Ihan siis lähdetään vaikka afrikkalaisesta tanssista liikkeelle. Niin siinähän on paljon sitä että tanssija tekee jotain rytmiä tai jaloilla, käsillä, mitä tahansa ja rumpali yhtyy siihen. Tanssija tekee jonkun liikkeen mihin muusikko reagoi.

8:16 Se olisi koreografille aika ihana, koska sä pääsisit testaamaan ja kokeilemaa. Silloin sä lähtisit nimenomaan liikelähtöisesti tekemään sitä teosta. Koska suurimmaksi osaksi aina tehdään niin että ensiksi on se musiikki sitten lähdetään rakentamaan siihen tai että musiikki luo sulle idean tai ajatuksen että mitä tässä voisi olla että sä näet sen musiikin liikkeenä edessäsi.

9:13 Mua kiinnostaisi nimenomaan että miten se kasvaisi. Että sulla on se yksi tanssija joka lähtee tekemään jotain tai että mitä tapahtuu kun siihen tulee kaksi tanssija että lähteekö se… Se olisi ihan mahtavaa ihan kokeilunkin kannalta… Enemmän ehkä sellainen liikekeskeinen (tanssiteos).

9:58 Mutta sitten mulla tulee myös tietysti opettajana mieleen että se olisi myös tanssin opiskelijoille ihan älytön tilaisuus ja kokemus. Että se varmaan myöskin auttaisi heitä siinä normaalin tanssimisen yhteydessä.

Appendix 3. Elmeri Pörsti interview

Interviewer: Eemeli Sutelainen
Interviewee: Elmeri Pörsti
Tampere, 26.9.2018
Transcription based on a recording of the interview
Length of the recorded interview: 27:17

0:02 (Haastattelija: joo just sitä mä käytin sitä NI Matea) Joo, mulla oli ihan sama. Mä tein tosiaan sen mun sähkömusan näytön osittain tanssijoiden kanssa yhteistyössä. Käytin totta kai tanssijoita siihen liikkeeseen. Ihan alunperin sen Kinectin käytön idea lähti siitä että kun oli ne tanssijat niin halusin ne jotenkin vuorovaikutukseen sen musiikin kanssa. Että he ei olisi vain vastaanottajia siinä musiikissa vaan että he tuottaisivat sitä.

1:52 Mähän hoidin sen aika simppelisti että mä ohjasin vaan NI Matesta tuli MIDI nuotit jotka sitten vaan Abletoniin missä mulla oli tehty eri trackit mitkä se aina laukaisi.

2:30 (Haastattelija: Että tuossa oli niitä triggereitä käytetty?) Joo sillain kanssa niin kuin se, tiedät kyllä kun siihen tulee ylös ne (trigger layerit) niin ihan semmoisella perus setillä.

3:10 Heillä (tanssijoilla) oli se koreografia ja mä silleen miksasin sitä.

4:48 Mun mielestä mulla oli pelkästään triggerit siinä. Mä huomasin siinä että se oli tanssijoiden koreografian suhteen heille helpompi.

5:04 Mä testasin niitä (vektoriominaisuuksia) mutta sitten lopputuloksen kannalta mä päädyin siihen että toi simppeli on parempi.

6:20 Se oli jännä kun kokeiltiin sitä niin huomattiin että jos kaksi ihmistä on tollain lähekkäin niin molemmat toimii, näyttää niin kuin periaatteessa samalta ihmiseltä. Että siihen saa niin kuin neljä kättä.

Appendix 1. Toni Honkala interview

Interviewer: Eemeli Sutelainen
Interviewee: Toni Honkala
Tampere, 27.9.2018
Transcription based on a recording of the interview
Length of the recorded interview: 54:15

7:45 …niillä modulaarin (syntetisaattorin) perus toiminnoilla tehdään, säädetään erilaisia parametreja. (Haastattelija: yhdistitkö Kinectiä modulaarisyntikoihin?) Ok, eli se oli siis sellainen juttu, että mä ohjasin sillä Abletonia. Mulla oli sen lisäksi sitten Kinect siinä, sitten se tarvitsi siihen väliin, mulla oli ensin sellainen ohjelma, sellainen ilmainen, netistä ladattava, softa joka käänsi sen Kinectin MIDI-dataksi. Tai sitten sellaiseksi OSC-dataksi (kyseessä Kinectar).

8:50 Sitten mä käytin kuitenkin loppuviimeksi sellaista NI Mate-nimistä (ohjelmaa).

15:20 Sitten piti ihan alkusi tehdä sillä tavalla että selkeästi heilutella että katsoja tajuaa että se käsi joka heiluttaa tyhjää ilmaa että se tekee sen äänen. (Haastattelija: eli käytit niitä triggereitä (NI Matessa)?) Joo, niitä mä käytin siinä.

17:19 Eihän se (esitys) olisi ollut yhtään mitään ilman niitä tanssijoita tai sitä Kinectiä.

23:40 Ne (tanssijat) reagoi niihin äänellisiin tapahtumiin. Että ne tietysti seurasi kun mä triggeröin niitä (ääniä), oppivat että mitä ääniä tulee mistäkin, ne niiden mukaan sitten yritti synkata sitä omaa toimintaansa. Sinänsä aika improvisatoorista se oli.