

The Interactive Music Producer

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Abstract

This paper introduces an investigation into the emerging role of the interactive music producer (IMP). This role has arisen as interactive technologies offer artists and audiences' new tools and opportunities to completely reinvent forms of music. The definition of an IMP's role will be clarified, evaluated and explored throughout this research. The research identifies the necessary skills underpinning cutting edge contemporary music practice. Focused research towards artistic approaches of interactive music making are needed due to the complex nature of developing interactive products, which usually involves custom-built software and expert interdisciplinary skills. This creates a huge problem for musicians and the music industry wanting to embrace changes in technology and communication. This research aims to address this problem by providing a new role that merges interactive technologies with traditional music making. The paper will introduce preliminary findings resulting from three creative works, utilising gestures, VR and performance. The creative practice involved building on existing skills in software and coding, producing interfaces and patches to experiment with while composing, recording, arranging and producing works that are fluid, adaptive and dynamic with audience interaction. By taking a bricoleur approach the researcher / artist is able to directly access potential impacts interactive technologies may have on contemporary music making and practice.

1 Introduction

A role is emerging in the professional music landscape as interactive technologies offer artists new tools and opportunities to:

- i. reinvent forms of contemporary music and
- ii. create immersive worlds to express their stories, ideas and works.

Sound artists and interactive artists have been experimenting with and developing interactive software and artworks in the media arts discipline since the early 1960s. (Chadabe 1984) This trend is growing in popularity due to:

- technology and software becoming more accessible;
- developing trends from remix culture;
- the digitization of popular art forms and cultural products;
- resulting changes to consumption and distribution methods; plus
- the popularity of gaming.

The disruption caused by the digitization of music has in turn driven new developments in music creation, distribution and audience engagement. The potential impact of interactive technologies on contemporary

music can be highlighted by the introduction of music technology, music hackathons, startup pitches and interactive technology at all major traditional music industry conferences and festivals, like SxSW, MIDEM and The Great Escape. (SXSW 2016) Further to these has been the success of the Music Tech Fest which supports cutting-edge artists and technologists changing the way music is made and performed (Nesta 2016). As musicians embrace new technologies in order to engage with audiences and search for new revenue streams to support their art, interactive music products are growing rapidly. (Dredge 2015) (Szirmai 2015) (MusicTechFest 2016) Although methods and artistic approaches in the field of interactive contemporary music making are limited.

Interactive technologies are vastly different except for the fact that they all produce data or a control input. This data can be mapped onto some kind of audio or sound synthesis parameter. Data could be produced from a variety of sources and interactions including but not limited to; gestures and dancing, mobile phone data from accelerometers or geo location, body data from one's heartbeat or jogging tempo, social media interaction, camera or video, visual interactions within virtual reality, body sensors, mouse events, touch screens and emotions like excitement or concentration

via a brain interface. All of these types of new interactive technologies require the manipulation of data to control a set of mapped parameters. Data manipulation becomes central to contemporary music making or, more precisely, the songwriting and production process.

The mapping of data presents a big challenge to contemporary music makers. Complex data analysis produced by interactive technologies needs to be classified and analyzed based on users interactions before the music mapping design can be achieved. New developments in machine learning software like Wekinator, Gesture Follower and ml-lib for Max and Pure Data; give artists new approaches for dealing with and classifying complex data sets.

However, this highlights one of the main issues in developing interactive music projects: the required set of expert skills. (Holland et al. 2013a) explain that Music Interaction involves the expertise of musicians, interaction designers and researchers and that these individual collaborators often play more than one role. In order to design an interactive music work one must also develop an interactive software system (Drummond 2009) which requires the expertise of a coder or computer scientist. Other skills may include sound engineering, graphic design, 3D animation, filmmaking, and visual art depending on the medium.

We are now in a situation where there are so many new approaches and expert skills required in music making for future music products. This creates a huge problem for musicians and the music industry wanting to embrace changes in technology and communication. This research aims to address this problem by providing a new role that merges interactive technology with music making. It is envisaged that the role of Interactive Music Producer will bridge the gaps between traditional music production, remix culture, gaming, music interaction and music information retrieval in performance and new music products.

In order to define this new role the research will investigate the impact of interactive technologies on contemporary music making¹. Through creative practice the researcher is able to clarify, evaluate, explore and define the role of the Interactive Music Producer.

The paper introduces preliminary findings resulting from three creative works including;

- i. GIRD – Gesture-based Interactive Remixable Dancefloor in collaboration with Jonathan Rutherford (Ars Electronica Futurelab) using IRCAM Ri-OT gesture sensors and Max for Live.
- ii. Coldcut Immersive – development of an interactive Virtual Reality concept album prototype. In collaboration with Coldcut, Ben Dawson (Immersive Construction and Melody VR), Justin Paterson (London College of Music) and Greg Smith (London College of Music)
- iii. MTF Viktoria Modesta Performance Lab – MTF Berlin performance lab collaboration with a team of interdisciplinary artists.

2 Related Work

There is a large body of related work and literature that goes beyond this paper. Below is a brief outline of the important research fields and works that underpins this research.

Interactive technologies are growing in popularity but are not solely responsible for the development of interactive art. Interactive Art is by no means a new area of expression. There is a rich documented history of artists working within this field (Kwastek 2015). Kwastek explains that from the early twentieth century “artists have increasingly sought to actively involve the recipient in their works and to stretch the boundaries of the traditional concept of the artwork”. (Kwastek 2015) Sweet, 2015 writes: “Before the twentieth century composers began to experiment with compositions by adding elements that would allow musicians to pick between different musical options at the time of performance, including phrase order and choices made about the instruments that make up an ensemble”. (Sweet 2015) Chadabe coined the term Interactive Composition back in 1969. He describes interactive composition as “a method for using performable, real-time computer music systems in composing and performing music”. (Chadabe 1984)

The field of Interactivity is focused around music interaction, which is a sub field of human-computer interaction. Approaches and research within the Music Interaction field provide key insights on interactive audio design approaches and audience behaviors. The book Music and Human-Computer Interaction (Holland et al. 2013b) and Jon Drummond’s paper on Understanding Interactive Systems (Drummond 2009) provide a key supporting framework on this research. “Interactive music systems use software to interpret human action to effect some aspect of music generated or modified by computers.” (Winkler 1995)

¹ Music making encapsulates the artistic process of songwriting, arranging, performing, recording, producing, distributing, promoting, and marketing. The music is defined as music currently being written, recorded and/or performed. This covers all genres of music making. Millie Millgate, 'The Sounds Australia Project Plan', (2013 - 2016).

To date the role of the Interactive Music Producer is still undefined. At this time no publications were found that address this issue. Due to interactive technologies becoming more sophisticated, the interactive field has seen a huge explosion in the last 20 years.

Contemporary recorded music has always adapted to meet audiences' demands and embrace new technology (Redhead 2015). This is highlighted by the history of Remix culture from producer-led movement of cutting tape. The success and growing community within Remix culture can highlight this. As technology develops, so too does the concept of remixing. Jamaican dance hall culture in the 1960s was a producer-led movement that created rearranged 'dub' versions of popular Jamaican music tracks. (Arroyo 2008). Artists like King Tubby and Lee Scratch Perry scratched records and cut tape to produce samples and loops. (Arroyo, 2008) This technical process required expert skills and expensive tools. The dub movement later inspired hip hop and electronic genres, which are entirely "premised upon the notions of sampling and remixing" (Hughes and Lang 2006) pg 16.) Importantly, this was a street-led movement resulting in artists adapting B-sides, versions or extended remixes thereby changing recording methods for their audiences who could then sample their music. The brief overview of remix culture is important as firstly, it gives an understanding of the creative and technological path from producer-led remix to consumer/user/fan-led remixing and secondly, it highlights the historical theme that artists constantly adjust to suit the demand of consumers. (Redhead 2015)

New interactive formats are being released and prototyped around collaboration and interaction with audiences from mobile apps, virtual and augmented reality, 360 videos, gesture sensors, controllers and brain interface controllers. Examples of this innovation can be highlighted by new interactive services like LastFM, Whitestone², Spotify Running, Ninja Jamm and Weav. Spotify Running creates a personalized tempo-based playlist based on the users real-time jogging rhythm. Ninja Jamm is an app that allows users to download music packs released on the Ninja Tunes label and remix tracks on their mobile. Weav is a new beta application that gives users the tools to change the tempo of music. The system also includes a GUI allowing producers to create stems that will work across different tempo for the app.

Over the past few years there has been quite a bit of media coverage on the idea of Album apps and what could be a new format for music. Bogdan discusses how album apps like Bjork's Biophillia offer a glimpse into

² A social platform that offers interactive audiovisual experiences. <http://whitestone.io/>

future music products. (Bogdan 2013) Many other innovative apps are also being released Peter Gabriel's Tiles, Daisy and the Dark's Red Planet and Massive Attack's Phantom.

3 Methodology

This research uses a mixed method approach through a combination of secondary research and creative practice. Criteria is developed based on grounded theory and action research. This criteria is tested by working with a conceptual framework for interactive songwriting and production processes.

This paper discusses preliminary insights and evaluations resulting from the development of three interactive music works. By taking a bricoleur approach the author is able to directly access potential impacts interactive technologies may have on contemporary music making and practice.

The interdisciplinary skills required in the role of The Interactive Music Producer include creative direction, music and sound creation, music interaction design, sound and audio design, remixing, composition, project management, systems development, data manipulation, gaming, interactive software, coding / hacking. These can be grouped into the following categories:

1. sound and music production;
2. interaction technologies³; and
3. data manipulation.

4 Experimental Results

Preliminary findings and insights of the three works will be discussed in relation to the conceptual framework which unpacks the fields of music and sound production, data manipulation and interactivity, as shown in Figure 1.1. These categories embrace diverse disciplines and approaches to interactivity applicable to contemporary music making.

(i) Gesture-based Interactive Re-mixable Dance Floor – GIRD

GIRD is a gesture based interactive audio and lighting system that allows audiences to remix, explore and interact with the music and lights through dancing and gestures. The project began in September 2015 when the researcher / artist and collaborator Jonathan Rutherford (Ars Electronica Future Lab) participated in a Hackathon at Music Tech Fest in Ljubljana

³ For the purpose of this study I will define Interactive Technologies as new technology that allows for the design and implementation of interaction with humans or systems

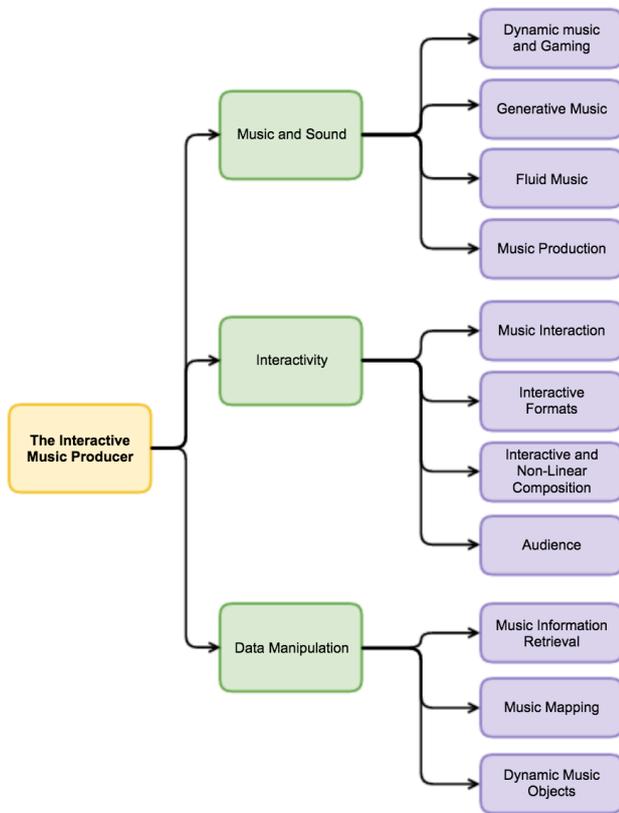


Figure 1.1

#mtfcentral. Their idea was chosen for a 3 month incubation as part of the European Commission funded #musicbricks initiative.

Category 1: Music and Sound Production

The system developed allows music to be explored, created, played with and remixed though dancing using a gesture sensor.

The prototype of GIRD uses the following music production software: Ableton Live, Max for Live, Max 7. New technologies have democratised recording processes. (Knowles 2008) Music software and Digital Audio Workstations (DAWs) like Garageband, Logic, Protools and Ableton Live allow musicians, engineers and producers to create recorded music products much cheaper and easier than ever before. Software like Max, Max for Live, Pure Data and Integra Live also make it more accessible for musicians to experiment with interactive composition and performance. Two important books Composing Interactive Music (Winkler 1998) and Max for Live Ultimate Zen Guide (Bayle 2013) provide an in-depth look at how to use Max and Max for Live software to develop interactive music and systems.

Category 2: Interactive Technologies

GIRD gives users the chance to explore and remix music through dance. It also allows musicians and producers to easily create and customize music for the system. There are many gesture-based projects in development including the work being done at Integra Labs Birmingham University and Mimu gloves.

Music and dancing work together. The popularity of Karaoke and Guitar Hero highlight consumers’ desires to participate in music. Humans love music, they want to sing and play along but more importantly they want to be able to move to music: to dance and let themselves go. The most important feature of this project is the development of an interactive music form that allows audiences to experience music they love in a new way.

When designing interactive projects it is key to understand the way audiences perceive music and the user experience. There is a vast amount of research on user experience within the music interaction field and again the book Music and Human-Computer Interaction (Holland et al. 2013b). The ability to explore music with different senses is key to interactive music as well as the way audiences perceive music. “The combination of pitch lyrics, harmony, rhythm has the power to put you in a certain emotional state, movement or emotional attunement, is it attributed by the music itself or by your perception?” (Zeiner-Henriksen 2016)

Audience perception includes the mind, body and action. Music allows us to perceive and move but not always to produce a sonic action in response, Music Interaction allows audiences to add a little bit of themselves into the music by adding another layer of action for the audience. The way the audience reacts to music and their expectation of music also changes with new technology, social, cultural and generational changes. When people hear music they react in different ways depending on the style of music, their environment and their own minds. For example when listening to classical music audiences might pay attention and really listen to the music - perhaps conduct along (Zeiner-Henriksen 2016). Dance music is meant to be danced to, Interactive music is meant to be interacted with. Data manipulation and Music Information Retrieval fields offer huge new opportunities to produce interactive music that audiences and musicians may perceive and act upon.

Category 3: Data Mapping and Manipulation

In order to expand the musical possibilities for a gesture based music composition and production, the music could be processed via a semantic system that analyses

a track in real-time and provides interaction options using Music Information Retrieval software.

Music Information Retrieval (MIR) is a subdomain of the Information Retrieval academic field, which can be defined simplistically as a way to sort, analyze, retrieve and categorize music. New technologies and research is rapidly expanding this field as methods are developed to extract and analyse music in real-time. MIR is the backbone to many new music distribution methods, interactive music projects and digital music products. Systems can predict styles of music that a user may like by querying “example songs, excerpts of recorded audio or even hummed melodies” (Lidy and Rauber 2009). The field provides opportunities for real-time music feedback with an interactive music composition.

MIR is an important area as it offers techniques and software to explore new interactive composition and production processes. An Interactive Music Producer would need to be aware of this domain and be able to understand how to integrate these elements into a work. The mapping and manipulation of data to audio parameters is also an important part of this new role.

Within the GIRD project data manipulation becomes central to music making or, more precisely, the songwriting and production process. The gestures and dance moves are designed by the musician and arranged by the audience. The music is then mapped to the gestures or dance moves for example raising your right hand could turn up the volume. Swiping from left to right could mix between two arrangements. Music could be supplied as stems, loops, processed via a semantic system, midi and audio instruments or in combination. The audio, instruments, effects and sound synthesis are mapped with the data produced by the audience’s gestures. The options are endless depending on the creativity of the artists and audience.

Interactive Music 3.0 (Quay 2012), Making Motion Musical (Bevilacqua et al.) and Drummond’s paper (Drummond 2009) discuss mapping and music and provide models and practices for data-based music mapping. Using interactive technologies like gesture sensors and brain control interfaces involves mapping the data received to control music parameters. Drummond, 2009 explains that “[C]onnecting gestures to processing and processing to response are the mappings of the system.” “In this model a performer interacts with a gestural controller’s interface, their input gestures mapped from the gestural controller’s outputs to various sound generating control parameters.” Bevilacqua, 2011 discusses how “the increase in sophistication of new devices that allow gesture and movement to be translated into computer

data holds great promise for interactive composition, dance, and creating responsive music in virtual reality systems. Data describing human motion can produce musically satisfying results by their impact on sound and musical processes.” (Bevilacqua et al.)

The mapping of data presents a big challenge to contemporary music makers. Complex data analysis produced by interactive technologies needs to be classified and analyzed based on users’ interactions before the music mapping design can be achieved. New developments in machine learning software like Wekinator, Gesture Follower and ml-lib for Max and Pure Data, give artists new approaches for dealing with and classifying complex data sets. Overall music and systems mapping strategies will help design the framework for an interactive project. Data manipulation therefore becomes another tool available to musicians in composition and production.

Another field of research that is built on data is Dynamic Music Objects. (Thalman et al. 2016) Dynamic Music Objects DYMO are “an amalgamation of audio files, structural and analytical information extracted from the audio, and information about how it should be rendered in realtime” or “flexible and modifiable musical objects that can be played back in various ways.” (Thalman et al. 2016) They offer multiple ways of manipulating users’ mobile phone data and mapping the data to produce dynamic music.

The research team at FAST⁴ are developing a mobile music player that allows producers and distributors to develop a variety of ways to control the playback of music so that it can be adaptive or interactive. (Thalman et al. 2016). The controls can be any data sensor source within a mobile phone. “Users can map mobile sensor data, user interface controls, or autonomous control units hidden from the listener to any music parameter exposed in the definition of a Dynamic Music Object. These mappings can also be made depended on semantic and analytical information extracted from the audio.” (Thalman et al. 2016) Thalman et al (2016) ‘s paper on Mobile Audio Ontology provides a detailed framework of DYMO’s including available parameters, representative systems and relationships for mapping and rendering audio parameters.

The skills required for an Interactive Music Producer highlighted by this project were Dynamic Music and

⁴ Fusing Audio and Semantic Technologies for Intelligent Music Production and Consumption (FAST) is a five year project funded by EPSRC. <http://www.semanticaudio.ac.uk/>

Gaming, Generative Music, Fluid Music, Music Production, Music Interaction, Interactive Formats, Interactive and Non-Linear Composition, Audience, Music Information Retrieval, Music Mapping, Dynamic Music Objects

(ii) Coldcut Immersive

Virtual Reality (VR) presents new possibilities for, and blurs the lines between, the creation and consumption of music and art. “Deloitte Global predicts that VR will have its first billion dollar year in 2016, with about \$700 million in hardware sales, and the remainder from content.” (Deloitte, 2016)

Category 1: Music and Sound Production

The VR album platform combines music and a visual/video interactive experience. It enables the further investigation into immersive music experiences and at the same time explores how gaming audio / middleware software allows for the composition of interactive music required in gaming.

This project highlights the need to understand gaming technologies, approaches and software and how these approaches can be merged with contemporary music making. Gaming software or audio middleware give composers flexible tools to create interactive or non-linear compositions. “Composing for games is very different than composing music for other linear media like film and television.” (Sweet 2015 Pg 49) “Video game music changes dynamically based on decisions that a player makes. The composer must score multiple outcomes and be able to transform music from one emotional state to another seamlessly” (Sweet 2015) Software plays a central role not only in the creation of interactive music products and performances but also in defining the role of the Interactive Music Producer. It is necessary to investigate a range of audio software and its importance given there is currently no standard in interactive music production.

Nonlinear music is another term used in music composed for games. Vickery, 2011 argues “the emergence of nonlinearity as a structural technique was a logical consequence of the increasing complexity of formal experimentation during the Modernist era.” He defines “the term Nonlinear, literally “not in a straight line”, has come to be applied to a broad range of approaches to musical form that are characterised by disjunctions, fragmentations, or apparent dislocations that give rise to structures that are incomplete, open or indeterminate in order.” (Vickery 2011)

Compositional and production for game composition are essential to this research as it provides a framework for how music can be dynamic. Definitions and techniques

are well defined in this industry. These need to be explored with other interactive technologies to create new forms of real-time interactive music for music products and performance techniques. Interactive music also provides the opportunity to include processes informed by generative music composition.

Generative Music is music created by a system that is unique and always different. It was popularized by Brian Eno. In his speech given to the Imagination Conference in 1996 he asks the audience “With this generative music that I played you, am I the composer? Are you if you buy the system the composer? Is Jim Coles (?) and his brother who wrote the software the composer? -- Who actually composes music like this? Can you describe it as composition exactly when you don't know what it's going to be? (Eno 1996).

The combination of dynamic and generative music with recent theories on ‘fluid music’ enables the musical output to be constantly in flux. Fluid Music is a term for producing changeable music forms relating to recorded and live music products. (Redhead 2015) It involves the creation of a song and it's components for a fluid format or open form (Tanaka et al. 2005), instead of a fixed format like a radio edit. It is this different method or approach to production, arranging and composing involving song loops, stem components and more. Cultural products such as vinyl, MP3 and CDs are physically fixed. With the evolution of analogue to digital these “frozen properties are more like fluid ideas” in their digital form, “appropriate for extension, recombination and innovation.

Category 2: Interactive Technologies

Using the Oculus Rift, HTC Vive headset and controllers, the new interactive music platform Coldcut Immersive aims to create entire worlds for each music track.

The author designed the audio interaction collaborating with Ben Dawson (Immersive Construction), Ninja Tune, Coldcut and Justin Paterson (University of West London). This collaboration involved the following software: Unity 360, 3D modelling, VR platform development, Wwise middleware software as well as 360 binaural surround sound and a vast knowledge of interactive music production. The combination of these cutting edge technologies will form the prototype of the first interactive, immersive VR album platform.

The user experience involves entering a 360 degree VR environment. Through play, interaction & experimentation the user can affect and control the audiovisual environment. This is achieved with the use of virtual movable objects, VR head tracking, vision,

gaze and interactive triggering. The user can record and remix the music produced within a 360 space and traverse across the virtual spaces of the project.

Category 3: Data Mapping and Manipulation

Data manipulation can also be seen in gaming composition. Game states, game parameters, triggers and events are a good set of tools to conceptualise a fluid piece of music that can be manipulated by data. Game states can be compared to different energy levels or emotional states of the user. A game state could indicate a villain close by or a fight scene. For example if a fight scene begins based on the users interaction the music will adapt and create suspense or action. This could involve new audio or a tempo change. The audio designer can also customize the transition of the music within the game state. Game parameters can control volumes and effects. Events enable the game developer and audio designers to control the overall structure of a piece.

All of these techniques can be explored using audio middleware tools like Fmod and Wwise. Sweet, 2015 provides a good summary of the way the music can respond to the control inputs given by the game or the user.

- “Cue switching and music form adaptation
- Dynamic Mixing
- Tempo and rhythmic manipulation
- DSP and effect application
- Stinger and musical flourish additions
- Instrument and arrangement alteration
- Harmonic approach, melodic adaptation, and note manipulation” (Sweet 2015)

The skills required for an Interactive Music Producer highlighted in this project were Dynamic Music and Gaming, Generative Music, Fluid Music, Music Production, Music Interaction, Interactive Formats, Interactive and Non-Linear Composition, Audience and Music Mapping.

(iii) Viktoria Modesta and the MTF Performance Lab

Category 2 Interactive Technologies

The author was invited to participate in the MTF Performance Lab⁵ in Berlin in May 2016. The researcher collaborated with a team of interdisciplinary artists consisting of experts in the field of brain interface technology, IRCAM gesture sensors, fashion and wearable design, performance, new software written for generative and responsive projection mapping,

⁵ <http://musictechfest.net/mtflabs/>

interactive LED light systems and sensor implants. The team integrated all this technology within three days to create a high tech performance in collaboration with bionic artist Viktoria Modesta⁶.

Category 3 Data Mapping and Manipulation

Viktoria had three sensors; MuArts⁷ attached a customized brain interface controller to her head, which read her brainwave activity. Two data sets were collected based on when Viktoria was in a meditative state or a state of concentration. The data produced by then controlled the volume of two recorded samples at the beginning of the performance. Two Ri-OT sensors were also placed on Viktoria. Firstly a sensor was placed on her prosthetic leg. Her leg now became an instrument that allowed her to trigger samples every time she stamped her foot. Also she could change the colour of the LED lights by moving her leg. The second sensor was placed on her wrist allowing her to trigger sounds by banging her fist in the air. Using the accelerometer data she was able to trigger sample clips within Ableton that were mapped using a custom build Max for Live patch.

Category 1 Music and Sound Production

This experience highlighted the need for an interactive music producer role. The author through collaboration was required to combine different interactive technologies within Ableton Live to control the audio produced in a live performance context. This involved designing the audio interaction, remixing and sampling the artist’s track, combining a range of data sources, categorization of data, creating systems in Max for Live to then map the data controlling volume parameters and sample clips. The experience was documented in Wired magazine (Schughart 2016).

A music production involves “...experts in playing musical instruments, in sound engineering, song writing, etc. Some production expertise is artistic and some is technical in nature, but in both cases, it is comprised of skills, specialized knowledge, mental information processing and perceptions filtered through experience.” (Lefford 2015) The music producer’s role in a music production varies depending on the skills and the vision of the experts involved. “Consequently, though they collaborate, experts carry through the production process different goals, priorities and perspectives relating to their individual work. Collaborations find means to accommodate diversity and differences.” (Lefford 2015) Lefford writes about how these collaborations and the coordination of experts work. He describes the producer’s role as requiring

⁶ <http://www.viktoriamodesta.com/>

⁷ <http://www.muarts.tech/>

knowledge of music theory, performance practices and sound engineering as well as knowledge of areas in communication and coordination. It is important to do further research on the role of the music producer and collaboration given this study aims to define a new role that bridges the traditional Music Producer's role with interactive technologies and data manipulation.

The skills highlighted in this project required for an Interactive Music Producer were co-ordination, collaboration and organization of experts across different media, data manipulation, editing, remixing, sound engineering, composition, creative directorship, concept creation, interactive system design, data mapping and music interaction design.

5 Conclusion

If music at a composition and production level was created with data manipulation at its core, there is the potential it could work across many interactive media and distribution tools. This could involve a new interactive music form that is developed from the creative process of writing a song instead of taking an existing song and extending or remixing it. The work itself is fluid and dynamic and can be changed and interacted with by software using data manipulation.

It is hoped this initial research will lead to further discussion and evaluation of the role. The paper presents this initial framework, which define the skills, disciplines and approaches to interactivity that could be applied to contemporary music making and the production of future interactive music products.

References

- [1] Arroyo, John (2010), 'Evolving the remix', <<http://johnarroyo.com/files/thesis/JohnArroyo-EvolvingTheRemix.pdf%3E>, accessed 2/10/2010.
- [2] Bayle, Julien (2013), *Max for Live Ultimate Zen Guide*, ed. Mark Towers (Lean Publishing).
- [3] Bevilacqua, Frédéric, Schnell, Norbert, and Alaoui, Sarah Fdili (2011), 'Gesture Capture: Paradigms in Interactive Music/ Dance Systems', in In G. Klein and S. Noeth (ed.), *Emerging Bodies* (Bielefeld, Germany: Transcript Verlag.), 183–93.
- [4] Bogdan, Georgiana 'Is the music album app the next game changer?', *The Guardian* <<http://www.theguardian.com/media-network/2013/aug/21/music-album-app>>, accessed 10/06/2016.
- [5] Chadabe, Joel (1984), 'Interactive Composing: An Overview', *Computer Music Journal*, 8 (1), 22-27.
- [6] Dredge, Stuart (2016), 'Streaming music's next leap forward could be "interactive artists subscriptions"', <<https://http://www.theguardian.com/technology/2015/feb/12/streaming-music-interactive-artist-subscriptions>>, accessed 11/4/2016.
- [7] Drummond, J. (2009), 'Understanding interactive systems', *Organised Sound*, 14 (2), 124-33.
- [8] Eno, B. (2016), 'Generative Music', <<http://www.inmotionmagazine.com/en01.html%3E>, accessed 11/04/2016.
- [9] Holland, Simon, et al. (2013a), 'Music Interaction: Understanding Music and Human-Computer Interaction', in Simon Holland, et al. (eds.), *Music and Human-Computer Interaction* (Springer London Heidelberg New York Dordrecht).
- [10] --- (2013b), *Music and Human-Computer Interaction*, eds Simon Holland, et al. (Springer London Heidelberg New York Dordrecht).
- [11] Hughes, J and Lang, KR (2006), 'Open Source Culture and Digital Remix: A Theoretical Framework', *Journal of Management Information Systems*, 23 (2).
- [12] Knowles, J D (2008), 'Australian Musical Futures: The New Music Industry', *Proceedings Australian Musical Futures: Towards 2020* (Sydney Conservatorium of Music, Sydney, Australia), 1-16.
- [13] Kwastek, Katja (2015), *Aesthetics of Interaction in Digital Art* (MIT Press).
- [14] Lefford, M. Nyssim (2015), 'The Sound Of Coordinated Efforts: Music Producers, Boundary Objects And Trading Zones', *Journal on the Art of Record Production*, (10).
- [15] Lidy, T and Rauber, A (2009), 'Music Information Retrieval', in Y Theng (ed.), *Handbook of Research on Digital Libraries: Design Development and Impact* (New York: IGI Global), 448 - 56.
- [16] MusicTechFest 'Music Tech Fest', <<http://musictechfest.net/mtfhistory/%3E>, accessed 11/4/2016.
- [17] Nesta (2016), '2016 Predictions - Audio Tech makes more than music', <<http://www.nesta.org.uk/2016-predictions/audio-tech-makes-more-than-music-sthash.YrkQP82G.dpuf>>, accessed 11/4/2016.
- [18] Quay, Yago (2012), 'Interactive Music 3.0: Empowering People to Participate Musically Inside Nightclubs', in Sølvi Ystad, et al. (eds.), *Speech, Sound and Music Processing: Embracing Research in India: 8th International Symposium, CMMR 2011, 20th International Symposium, FRSM 2011, Bhubaneswar, India*,

- March 9-12, 2011, *Revised Selected Papers* (Berlin, Heidelberg: Springer Berlin Heidelberg), 89-97.
- [19] Redhead, Tracy (2015), 'Composing And Recording For Fluid Digital Music Forms', *Journal on the Art of Record Production*, Proceedings of the 2014 Art of Record Production Conference, University of Oslo, Norway. (Issue 10).
- [20] Schughart, Anna 'Behind the scenes of Victoria Modestas transhuman stage show', <<https://http://www.wired.de/collection/latest/hinter-den-kulissen-von-viktoria-modestas-auftritt-auf-dem-music-tech-festival>>, accessed 10/06/2015.
- [21] Sweet, M (2015), *Writing Interactive Music for Video Games: A Composers Guide* (US: Pearson Education Inc).
- [22] SXSW 'About the 2016 SXSW Interactive Festival', <<http://www.sxsw.com/interactive/about%3E>, accessed 10/06/2016.
- [23] Szirmai, Barbara 'On The Verge Of Art And Technology - Interactive Music Projects', <<http://videopath.com/on-the-verge-of-art-and-technology-interactive-music-projects/>>, accessed 11/4/2016.
- [24] Tanaka, A, Tokui, N, and Momeni, A (2005), 'Facilitating collective musical creativity', *Proceedings of the 13th annual ACM international conference on Multimedia %@ 1-59593-044-2* (Hilton, Singapore: ACM), 191-98.
- [25] Thalmann, F., et al. (2016), 'The Mobile Audio Ontology: Experiencing Dynamic Music Objects on Mobile Devices', *2016 IEEE Tenth International Conference on Semantic Computing (ICSC)*, 47-54.
- [26] Vickery, Lindsay Ross (2011), 'Exploring New and Emerging Models for Nonlinear Performative Works ', (QUT).
- [27] Winkler, Todd (1995), 'Making Motion Musical: Gesture Mapping Strategies for Interactive Computer Music', *International Computer Music Conference*.
- [28] --- (1998), *Composing Interactive Music* (The MIT Press).
- [29] Zeiner-Henriksen, Hans T. 'Music Moves', <<https://http://www.futurelearn.com/courses/music-moves/1/steps/60300%3E>, accessed 10/06/2016.