Live Steering of New Media Arts
Developing an interface that generates moving kaleidoskopic imageries for live performances
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ABSTRACT
New media is a phrase that doesn’t have a set definition. It consists of a large body of activities and channels, which are mostly concerned with information transfer, digital interactions between people and a view of the world as seen through the lens of digital instruments of communication. In the world of art, new media technologies have shifted the perception of what an artwork is, how to create art and how to experience it. New media has changed even the idea of what makes somebody an artist. Curators, galleries and ownership play a secondary role in this world. Exclusivity is no longer a trait of a piece of art, but an impediment. This paper describes the process that I undertook while developing an interface that aids with the creation of a particular genre of new-media artworks, and in live performances, the description of performance done using this software, some historical content, current issues and my own thoughts on the subject.
Acknowledgements

First of all I would like to give a huge thank you to my supervisor, Professor Henry Gardner, for giving me the idea and opportunity to work on this project and for offering guidance throughout the whole process. In doing so, he helped me open doors that I didn’t know existed in the fields of Computer Science and Creative Arts. Also, a warm thank you to Andrew Quinn for teaching me the software that I used in the development and learning process, to my learning colleagues (JP, Gareth, Kit, John, Chloe, both Bens and Darren) from which I got artistic ideas and technical guidance, to my family for existing, to all my sources of inspiration and to the whole existence for making this happen.
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1 Introduction

The scope of this project is the development of an interface that will allow its user to create and steer an original audio-visual performance, in front of a live audience. Using a specialised software package, Touch Designer, I aim to develop a framework that will abstract some of the technical processes that are involved in the creation of a digital artwork and in doing so providing an easier way for uninterrupted expression. The piece that I will perform using my framework will be recorded and distributed online, as part of a new-media performance. By doing this a wider audience will take part in viewing the artwork and potentially using my framework, which will allow me to improve future iterations of it.

The reader will find in Chapter 2 some background information about what is New Media, artistic processes in this field, what is Live Steering, how do the two combine, my personal motivation and involvement in this field. In Chapter 3 I discussed the process that I undertook while learning from a New Media Artist the software and concepts required for me to design this interface and also the artistic choices I made for a performance that I showcased. In Chapter 4 I have discussed the technical implementation of this interface, Chapter 5 covers possible future work, Chapter 6 some thoughts on the impact of New Media on the world and of Live Steering in the practice of digital arts and Chapter 7 concluded this paper.

2 Background

In this chapter I express my interest in this field and I offer some background information about New Media, New Media Arts, Live Steering and the connections between these fields, including New Media’s history, its evolution over time and some example works of art. I also include an overview of the software that I used, Touch Designer.

2.1 Personal Motivation

There are two personal reasons that guided me in pursuing this project: Creative Arts and Computer Science. In contradiction to the apparent lack of connectivity between these two disciplines, many possibilities of artistic expression can appear when making computer-aided art: from the raw, primitive imagery that can be created by coding in a language such as Processing (www.processing.org); to the intricate interactions, generative works of art and special effects for movies created with the aid of dedicated software; and the blending of computational capabilities in traditional art such as choreography, dancing, poems or music. [1]
I come from a background of mathematics and found it easy to get into programming in high school. As a second year undergraduate student undertaking Bachelors of Arts and Bachelors of IT, my experience with these two disciplines has been comprised of a few important topics of each area, gained mostly through learning, practice and personal projects. I have been studying computer science for 6 years, focusing so far on imperative, problem-solving programming and software development.

As for the arts, I started with (break) dancing at the age of 10 and became a graffiti artist when I was 13, for about 5 years. I then shifted towards computer-aided arts, starting with music production using DAWs\(^1\), and later getting into photographic manipulation, illustrations and video compositing\(^2\). In retrospect, at least half of the time that I engaged into an artistic activity, it was with the help of computers.

Having said so, I see this project as an exploration of new artistic possibilities for me and the readers of this report, as a way to create a useful tool for other people to enjoy and learn from, and as a means of learning.

2.2 What is New Media?

New Media is a field that covers a wide variety of practices and activities, which mostly surround information and communications technology (ICT) in the present age. Because of the nature that it encompasses, and of its name, a set definition for New Media doesn’t exist, as it would have to be revised every few years. There are several concepts and activities that directly relate to New Media, but first let us further explore the different meanings of the word ‘media’.

*Media* is the plural of medium, which comes from the same Latin word (literally meaning *middle*). Generally used in the context of communication, ‘media’ is defined as “Communication channels through which entertainment, education, data, or promotional messages are disseminated. Media includes every broadcasting and narrowcasting medium such as newspapers, magazines, TV, radio, billboards, direct mail, telephone, fax and the Internet.”\(^3\)

Another definition of media is “The main means of mass communication (especially television, radio, newspapers, and the Internet) regarded collectively.”\(^4\)

Old, or legacy media as opposed to new media, are regarded as *traditional means of communication that have existed before the advent of digital computers and communications*, including books, magazines, pamphlets, movies, radio shows or cable television\(^5\). Unless they include a way of digital interaction, TVs, movies or magazines are not considered part of the New Media. Based on these definitions,

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\(^1\) Digital Audio Workstations such as Ableton Live and Fruity Loops
\(^2\) A personal video project: https://vimeo.com/132084693
\(^3\) http://www.businessdictionary.com/definition/media.html
\(^4\) https://www.google.com/search?q=definition+of+media
\(^5\) https://en.wikipedia.org/wiki/Old_media
traditional media is generally a one-way communication, based on the \textit{one sender - many receivers} paradigm, which most of the time do not swap positions.

New Media is slightly different in that respect. Brandon Vogt \cite{2} considers that a defining characteristic of new media is the \textit{dialogue}, the ability to communicate through and from, \textit{interchanging} the roles of sender and receiver; he also considers that the ground on which it stands is \textit{interactivity}. Compared with traditional media (acting closer to a monologue), New Media doesn’t emerge from a one-way flow of information, that mostly features static content, where receivers of information have no input and rarely become senders, but it evolves as a many-way dynamic type of communication, having its content created and reshaped by all the participants, similar to a \textit{conversation}, or to a \textit{group discussion}. Some trivial examples are seen every day in social media, where Facebook posts get viewed, commented and shared amongst users, or Tweets get re-tweeted, exponentially more people having access to interact with them after every iteration.

Another distinguishing characteristic of New Media is the form that it takes. There are many ways to create and perpetuate it: through social media, web sites, augmented reality or computer-generated imagery, to enumerate a few, but essentially, New Media is a string of 1s and 0s; it is digital content (here is where the question \textit{“Is a painting of a Tweeter post considered a work of new media?”} doesn’t have a clear answer; but I would argue that it’s an old fashioned way of showcasing the idea). Any data that can be accessed from, interacted with via, transmitted through and manipulated using a computer-based device can be regarded as part of new media, that is if it’s intended for a large number of people.

However, New Media is not only concerned about the content or means of communication. Lev Manovich accentuates the importance of the cultural objects used in the process of creating and interacting with it. \cite{3} Take the iPhone for example: in how many ways did it change the \textit{way we act with and how we see the world}? By taking out the buttons, it redirected the whole mobile industry. All other manufacturers changed their focus to making touch-screen phones (technology that has existed almost half a century before the iPhone\footnote{7}). This device also gave way to the age of mobile \textit{apps}. How well known are apps like

\hspace{1cm} 6 \url{https://www.flickr.com/photos/wakingtiger/3157621862} \hspace{1cm} 7 \url{https://en.wikipedia.org/wiki/Touchscreen#History}
Angry Birds, Flappy Bird or Fruit Ninja? Aren't these, in an unusual way influencing our ways of thinking? Aren't they part of our culture?

2.3 Creative Arts in the New Media Genre from the Beginnings until Now

The development of New Media processes began around the same time as the development of modern computers [3]. This isn’t surprising; new media is greatly dependent on computers, while computers benefits from the existence and technological advances made towards the improvement of new media. These events are marked by the invention of different static or moving photographic instruments, like the zoetrope (1834) or the daguerreotype, and the first wholesome design of a general-purpose computer, theoretically being able to do everything modern computers can (Charles Babbage's Analytical Engine), in the late 1830s.

![Still from “Lumia”, by Thomas Wilfred](image)

However, major works of New Media Art didn't appear until the beginning of the 20th century. An example of such an artwork is Thomas Wilfred’s visual-music art, called “Lumia”⁹. He created the Clavilux (1919 - colour organ), a projection instrument that used organ keys to generate colour, sound and light, as a result of which he is considered a pioneer in the domain of New Media Arts and one of the first artists to work directly with light as a medium; he was thus considered a 'sculptor' in light.

In the 1970s and 80s New Media Art began emerging as a self-contained entity, but it was very much part of the underground movement, because it involved never-before-heard-of concepts. One such example is “distributed ownership”, which began to rise as an idea after Roy Ascott’s first telematics project in 1983, when he together with artists from all over the world created “La plissure du Texte”¹¹, a distributed narrative work that took place over a 3-weeks period, each artist inputting text from a different location in an improvised manner, from the perspective of a story character, the whole initiative resulting in a “Global Fairy Tale”.

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⁸ The first photographic process, by Louise Daguerre
⁹ [http://www.lumia-wilfred.org/content/intro.html](http://www.lumia-wilfred.org/content/intro.html)
¹⁰ Mainly considered as computer-generated imageries
¹¹ [http://alien.mur.at/rax/ARTEX/PLISSURE/plissartx2.html](http://alien.mur.at/rax/ARTEX/PLISSURE/plissartx2.html)
The beginning of the 90’s took NMA out of the sub-culture and into the mainstream world of art. However, artists, curators and art-enthusiasts still didn’t find it easy to work around the paradigm-changing ideas that NMA introduced. In the eyes of Lev Manovich, the world of art could not let go of the old fashioned view of the piece of art as a single object created by an artist and distributed exclusively, through art galleries or museums. This didn’t leave much space for the infinitely many copies that a new media artwork can have, the various remixes that can emerge from a single piece, the many locations in which it can be exhibited or experienced at the same time (potentially all computers in the world) and the symbiosis between the artist and the user. [4]

In the present age, the boundaries between humans and technology are thinner than ever. These borders were explored in intricate and thoughtful ways by some, and in non-conventional ways by others, as can be seen in the works of digital artists like Wafaa Bilal12, who implanted a camera in the back of his head for one year (2010-2011) which randomly photographed places he went through, or of Melbourne-based performance artist Stelarc13 who successfully implanted an ear into his arm, which will be followed by a microphone implant that will record and stream every sound around him, for an indefinite period.

A great part about NMA is that, unlike others, artworks from this genre can be exhibited as static or dynamic objects, allowing for different degrees of interactions. They can be created in real time as an unplanned (freestyle) performance and then exhibited (in a gallery or online).

3rdi – Wafaa Bilal’s head-cam implant, rejected by his body some months after the operation14

13 Ear on Arm http://stelarc.org/?catID=20242
14 Photo Link: http://www.oneart.org/galleries/wafaa-bilal-3rd
2.4 Live Steering of a New Media Performance

Live steering is the activity of conducting computer-aided artistic performances (generally audio-visual) using digital media, in front of a live audience. Some examples of live steering practices include producing visuals to accompany music in a club, steering concert lighting, live looping15, live coding, creating and participating in interactive digital-art galleries/exhibits, conducting live music production sessions, etc. Here, “computer-aided” doesn’t only mean having an actual computer involved, but also having an instrument that involves some computation, be it a normal drum-machine, a portable dynamic-phase synthesizer, a Microsoft Kinect or an Apple iPad.

There is a wide variety of computer programs that aid in the development and delivery of live-steering practices such as: tools for music production and the live streaming of music16, DJ and VJ17 practices, lighting18 performances, or more complex artistic projects.

Depending on the scope, size and resources of a project, one might find everything that one needs for free or not. Generally, the higher the quality and better resources of the software, the more expensive it gets. However, software is not all, as you can have the best software in the world, but if your machine doesn’t rise up to the program’s requirements, the performance will not be any good. For example, a live-coding performance (here understood as the activity of generating music in real-time, in front of an audience, by writing computer code) should generally not need a very good GPU (as it doesn’t technically use any graphic processing) and more than 1-2GB RAM, but a good sound card might be an asset. However, if one plans to run visuals from the same computer, then hardware requirements should be reconsidered.

Some languages that support run-time compilation (aiding in live coding or programming) and that are generally used for artistic purposes are Extempore, ChucK, Scheme Bricks and Daisy Chain. These languages also offer a type of code visualisation which is different from that generally used in modern IDEs, of highlighting and colouring different elements of the syntax; for example, Scheme Bricks offers visualisation based on colours and blocks. Code visualisation is an important part of the programming endeavour in general, as it offers the programmer a different view on his code, but it also for artistic purposes as it enhances the experience that a user has. [5]

2.5 Touch Designer

Touch Designer (TD) is a procedural graphics and audio processing software aimed towards real-time computations. It started as being a derivate of Houdini, a 3D animation program used in new media production, and now it evolved into a wholesome environment used for a multitude of purposes and has been an

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15 The activity of recording and playing music live, using a looping instrument
16 Ableton Live or Reason
17 NI Traktor and Virtual DJ for DJ, VJAM and AVMix PRO for VJ (Visual Jockey)
18 Visual-3D or ShowXpress
important part of many large scale projects. It can also be considered authoring software as it aids its user in creating original interfaces for digital interactions.

Encompassing a wide range of activities and instruments, being used by both the (media) industry and creative individuals for about 15 years, this software has vast amounts of online resources for learning and task-based practice, and a large user base that forms a helpful online community when in need of clarifying any technical issues. There is also the option for paid support (from the Derivative company).

Touch Designer works as a node network: a node (or operator) can either generate, import or change the data that is inputted into it, sending it to another node. TD uses nodes to receive and send data to and from a range of inputs, such as text, audio and video files, displays, 3D scanning, motion sensing devices, geometries from other software and even live streamed data. Nodes can generate buttons and sliders that affect certain parameters, they can combine with other nodes using different merging algorithms, they can apply audio or image processing effects on their inputs or they can contain user-written Python algorithms that interact with the network’s parameters in various ways.

As for software used by a lot of people, many plug-ins and libraries are already available; TD can be coupled with other widely used software instruments, like Ableton Live or Adobe Photoshop. It uses conventional file formats, can import 3D geometries from 3ds max, Maya and Houdini, it supports various communication protocols, can read data from various formats (such as XML, HTML, JSON) and can be used with Python or TScript code snippets, offering a great asset to programmers.

3 Andrew Quinn Workshop and Performance

As part of the learning process required for building this digital artefact I attended a one-week intensive course on Touch Designer, presented by Andrew Quinn; he’s an Australian multimedia artist who has worked on a wide variety of projects: from compositing for Hollywood blockbusters, to exhibiting art at world-renowned cultural exhibitions. He was using Houdini in his early days and then switched to Touch Designer, making him the perfect lecturer for this course.

The workshop lasted for 5 days, ending with a performance showcasing what the participants had created. The schedule was 9 – 5 with a two-hour break; a lot of concepts were covered during that time, but not all of them in depth. The

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19 Touch Designer Website: https://www.derivative.ca/088/Applications/
20 Microsoft Kinect, Leap Motion.
21 OSC, MIDI, TCP/IP, UDP.
22 Touch Designer’s scripting language
23 www.andrewquinn.org
participants of this program were from across three collages of ANU: three were studying music, five visual arts and myself doing computer science. In the first three days we intensively learned the TD workflow along with concepts used in it, but also throughout various graphics and real-time software. We also learned tips about how to make effective visuals without spending a lot of effort. In the last two days we focused on setting the scene for the performance and working on our final projects.

3.1 Day one
The first day started by meeting the other participants and learning the basic workflow of the program; this day was mainly focused on image manipulation procedures. We briefly touched upon concepts that were to be explored more in depth in the next days, such as video mapping, audio reactive visuals and using MIDI instruments to interact with the performance. Andrew showed us some tricks that use simple concepts to create effective visuals, and discussed how these concepts relate to various graphics software tools.

![Figure 1.0 - Feedback Loop Node Network](image)

An interesting concept covered in the first day was the “Feedback Loop”, as illustrated in Figure 1.0. It works by taking a visual input, putting it through a feedback node, transforming it (by rotation or scale) and turning the opacity a bit down (to about 96%), after which the original and the transformed images are combined together using an ‘Over’ algorithm (in the ‘comp1’ node). The feedback loop also stops in the ‘comp1’ node, in the same way as a while loop only loops what’s around its brackets. To illustrate this, if the input was a picture of a banana, transformation would rotate the image 90 degrees, we would see four overlapping bananas (fig 1.1). If the image would also be scaled down, we would get a spiralling effect (fig 1.2).

![1.1 – image after a 90 degree rotation, feedback looped](image)
3.2 Day two
On the second day we explored sound analysis and how to generate visuals from it. For starters, we analysed the amplitude of a sound file and changed the colour and shape of an image based on that. Then, we used a Spectrum Analyser Operator to get the audio spectrum of the sound, translated that into a 2D line, then changing its colour, rotation and movement based on different (some random) inputs, like the time code or a noise function. In the end we applied shades, light and other effects to smoother up the final product.

3.3 Day three
On day three we discussed and applied concepts that helped for a more in depth understanding of the graphics processing unit. One concept that we explored was geometry instancing, or the activity of generating multiple copies of the same object (mesh) at once, as opposed to generating multiple different objects. This relates to OO programming, where you have a blueprint out of which you can create 1000 slightly different objects, instead of having to write that blueprint 1000 times. In order to illustrate this example we used particles; we instanced one particle to the GPU (a very small sphere) and used that to create a system of many particles, each of them acting in a different way, with different life spans, speeds and directions of moving, but coming from the same source.

As a way of combining different concepts studied so far, we analysed the amplitude of a song over time and converted it into a 2D line; then, using GPU instancing we created particles that sprung into existence based on the shape that the line takes.

3.4 Days four and five
The first part of day four was spent in the labs, where we explored input devices such as a web-cam, motion sensing devices Leap Motion and Microsoft Kinect.
Each of us did some work that was to be part our final projects; next we moved into the performance room where we started planning and setting up the scene. By the end of this day I had a rough idea of what I was going to perform and an early stage prototype of what became the final interface. Most of my peers spend all of day five inside the Big Band room, where the performance took place. I stayed home to polish the software and make it work as a performance tool. This is the day that I developed the audio analysing tool which was used in the performance and is also part of the final artefact.

3.5 Performance

Our performance took place on Friday, the 18th of September 2015 from 7:30 pm inside The Big Band Room, Peter Karmel building, ANU campus in Canberra, Australia.

The interaction I designed features a visual narrative inspired by “We want your soul” a song that I used in my first two performances, composed by Adam Freeland and remixed by electronic music duo “Klangkaroussel”.

The title and lyrics of this song illustrates the desire of an elite group of people to control every aspect of everyone else’s lives, a group that uses its influence to systematically dumb down the masses, by infusing false values into their thinking and by presenting lies as facts. The end goal is to turn everyone else into pseudo-thinking civilised robot that is “smart enough to operate our machineries but dumb enough not to realise what the point is”. Spoken by a semi-robotic women’s voice, the lyrics don’t tell a story in the regular, narrative way, but contain the raw messages that mass media perpetuates and that can be seen in every-day social interactions through short phrases24.

Figure 2.1 – parallel lines

I designed the initial performance to contain three major parts. Regardless of the user’s input of sound and image, the first part shows 64 parallel white lines along a plane; in the lower part of the screen and over a black background (fig 2.1), each line represents the life a human being, but the whole image expresses formality, ‘fitting’ into society, similarity, lack of individuality and of personality, boredom and the idea that this is how it will always be and there’s nothing more to life. The scarce appearance of faded rainbow-like colours on top of the lines represents the little pleasures that you get from apparent accomplishments from within the system, but also the fact that there is always something deep inside that tells us when things are right and wrong; they illustrate the hope and the always present possibility of escaping the prison of the mind.

24 http://lyrics.wikia.com/wiki/Adam_Freeland:We_Want_Your_Soul
As the music starts playing, the lines fade up and down (fig 2.2) moving forward and leaving a trace behind, representing the fact that art (music) is a way of true expression and a way out. As the music intensifies, the lines change shape according to the audio spectrum of the song, coming out of the norm; from 2D we get to 3D. These sudden changes represent the outcasts, mentally-ill, criminals, socially unacceptable behaviours which are a reflection of the negative forces that sometimes the whole world embodies, and not separate, isolated cases, as we tend to think of them; they are being isolated and ‘put away’, ignored and misunderstood, instead of properly treated and reintegrated.

After a while of the music playing (1/4 of the actual playtime of ~ 7 minutes), the second part fades in (this choice is up to the user, there’s a slider that makes this change). Part two is a static sphere or cube (or any other geometry that a non-novice touch designer user wants to input) situated above the parallel lines, in the centre of the screen (2.3). Black and white for now, the texture of the geometry is a user inserted photograph. The slow fade in of this new object represents the slow process of realisation that takes place on earth at this moment in time, which is the realisation of better, simpler, more healthy and in tune with the universal intelligence, new (or old) ways to live and perpetuate the beauty that exists. The lines are still there, because until a critical mass of people realize, little can be done. This new geometry represents the awareness that “there’s something here beside us”.

Until now, not a lot of steering took place, because long parallel lines that are audio reactive don’t need steering. I use this as a metaphor for “Everything is provided; you just have to work in order to buy things at your local supermarket, watch TV and play sports in the weekends. You want to be considered socially acceptable, and never think about ‘in what way is this action that I
am doing right now going to affect something or somebody else?".

Leaving the metaphors for now, having a static object in the middle of the screen is boring; three sliders affect the speed and distance of movement in 3D, the speed of rotation and the intensity with which the geometry changes shape, each representing the confusion, struggles and responsibility, but also the freedom that comes with being a critically thinking, free of self-induced barriers human being that uses its brain as a humble servant, or tool instead of a guiding master. Gradually, as the music heads towards the drop (climax), the shape moves and rotates faster. When the first beat drops (halfway through the performance) the artist has a few choices to illustrate this. By default, when the kick hits, the shape of the geometry changes rapidly (thanks to frequency analysis), illustrating an effective visualisation of the song. You can tile the screen into 4 (2.4), start the first feedback loop (2.5), bring in some colour, or do any mixture of them (if the user steers with a midi controller, or something more complex than a mouse). This climax represents the realisation that there is an “elephant in the room”. From here the artist may play with the rotation slider, colour, opacity, and so on. At this stage the screen might or might not, depending on the changes, feature an idea of sacred ancient art like illustration, but not very clear. This might mean the flashing, unclear awareness that there might be something out there that is greater than us human beings, a glimpse of a supreme consciousness that is embodied in every living and non-living thing in the existence.

At this point of the performance (two thirds into it) most of the features might have been used. However, the most effective one, which uses a mix of all of the features illustrated before (feedback, tiling, colour) represents the moment when we all realize the connection between all life and the timelessness of being, by a (theoretically) infinite spiralling loop, generated from the same, unique source (3D geometry). It might mean the realisation of one that one is the same as, and inseparable from God, and that the body, or the ego (represented here by the
Initial lines are not what being really is, but rather a fleeting material reflection trapped time and space.

After this realisation, there are a few different ways to get out from the colourful fractal-like loop (as illustrated in Appendix 1) to the normal shape, gradually slowing down its speed of movement and rotation, and fading it out until we are back at the initial lines, preferably at the same time when the song stops. Only now, the lines are black and the background is white. This represents the good feeling that one has after an enlightening dream that he can’t remember, but will always know it in the heart.

4 Interface Implementation - ‘Kaleido-Utopia’

In the following chapter, I will explain the steps that I took in order to create this artefact, the driving factors behind design, technical and artistic choices, and also the goals that I wanted to achieve building this artefact.

4.1 Problem Definition

Touch Designer is an authoring software that provides a number of tools to help in developing interfaces for new media art shows. Given its complex nature, not all users will find it easy to use, some finding it hard to accomplish even trivial tasks. My aim was to allow users of my system to experience some of the artistic possibilities that TD offers, while abstracting the technicalities involved. At the same time I wanted to provide a less complex authoring tool which can be used in steering a live media art show.

An expert user can easily create intricate applications for steering generative visuals, audio visual synchronization or what have you; even users that have limited experience in using computer graphics software can, without struggling, develop effective interactions. However, the novice user is easily inhibited by the diverse amount of concepts needed to be understood in order to materialize even a simple idea, even if most of them are the same throughout the field’s most widely used software tools. It is true that a novice should start graphics processing with a less complex piece of software until he/she has a strong grasp of the basic concepts, however simple is also limiting especially for the inexperienced, and can potentially destroy the desire to learn.

Therefore, I have provided an original interface in the form of a Touch Designer plug-in that intensively abstracts most of the technical aspects that come with graphics processing software, while offering enough flexibility to allow one to create an original piece of new media art that can be steered in real-time. This interface includes an audio analysis tool which separates the low, mid and high frequencies of the audio input that it is given and uses these channels, each in a different way, as a means of interaction with the visuals. The audio analyser is a module which can be used on its own, in other Touch Designer interfaces.
4.2 Technical Implementation

Having as main focus the idea of live steering, I designed this interface in a way such that it works best when using a midi controller, with either sliders or knobs, and a few buttons. A mouse or laptop pad will also work, only that the performer will be restricted to tweak one effect at a time.

The theme that is featured in the initial prototype is comprised of three modules (each having an individual container). One of them is the Audio Analysis, another is the Visual Generator. The third module, CONTROLS, manages the GUI (how the knobs and buttons are arranged and where each of them is assigned to).

Each major part of this project is situated within its own container (folder) and within each container more nodes and containers are present. This is a way of encapsulating the contents of the plugin so that they are easily accessed, changed and potentially used in other projects. This way, interdependency is minimised while coupling is maximised.

Figure 3.0 – Main folder of the project, featuring the 3 main modules
4.2.1 Visual Module

Contained withinVisual Generator (3.1), this is the most important module of the implementation; the major features are within Container1; Edge node takes the edge outputted from Container1 and Switch fades between Edge and Container 1; inside Container1 (3.2) are, as following: a rendered geometry (Geometry Generator) given as input for a Shadow Generator, which goes through a feedback loop contained within Under Over Loop, continuing to a Tile node which splits the input in 4, the output of that going through another feedback loop (Deep Loop).

I – Geometry Generator

The node network in Figure 3.3 illustrates how the geometry is generated and pre-processed: We have a Geometry (called geo1), Camera and Light containers (needed for a 3D object) which are all rendered within Render; Phong makes the material applied to the geometry, taking its input from the purple node in1 (input from outside this container), which is then resized in Transform and
changes its colour over time, using a python expression within the HSV adjust node (hue, saturation and value adjust).

3.4 – Within hsvadj1, the hue value is being changed over time.

The green nodes noise1 and noise4 randomly generate numbers which are then scaled down using math nodes and passed, through null nodes, as inputs into Geometry, affecting the 3D position and rotation of the geometry.

3.5 – Python expression affecting the Geometry’s Z position; Using the random value from null1 and the input of the user from project1/CONTROLS/null15, the z position of the sphere is changed.

Inside the GEOMETRY (geo1 – 3.6) container, SPHERE is passed through NOISE which, using the user input, deforms the shape with a certain amplitude (3.5); however, if a low frequency (from the song) hits a certain level, the amplitude of the noise will be three times the one inputted by the user, offering a nice visualisation effect. FACET computes the normal of the shape, outputting a better defined one. The NULL nodes don’t affect anything, they’re only there to be referenced (in case further nodes will be attached, they will be attached before NULL).

3.5 – Noise frequency based on a node from the user input (CONTROLS) and audio analysis (AudioChan)

Light and Camera nodes are the default ones provided in Touch Designer. After rendering the geometry as a 2D image, I outputted it through shadow (shadow generator using loop), then UnderOverLoop (first kaleidoscopic loop), a tile node and then through DeepLoop (second kaleidoscopic loop).

II – Shadow Generator (3.7) makes a shadow like trace by splitting the original input into three outputs, applying effects and combining them back together. The white contour (generated taking the alpha channel of the input and putting it through Edge) is combined with the original input in Composition3 using a multiply algorithm, leaving a thin black contour of the shape. The first contour is at the same time looped, until Comp2 (which combines the two inputs using an ‘add’ algorithm); the shadow is done here by the node Displace, which displaces each pixel of the source image (transform2) according to the corresponding pixel from the displace image (Noise). Lumalevel diminishes the opacity of the input; we then combine the original image over the shadow one (in composition1).
III - Under Over

This container features a feedback loop. The z-rotate value from within Transform can be changed by the user (through the Loop Rotation slider of the GUI) and it ranges from 0 to 180 degrees; so can the opacity within Level, between 0 and 0.98; more than 0.98 would generate a white screen. It's called this way because the user has the ability to choose whether the source image will go under or over the looped image (Loop Over button), offering two different outcomes (3.9), especially when combined with other effects.
**IV - Tile** offers a nice effect using a single node; the important parameters within this node are controlled by the user via the crop left, right, top and bottom sliders, situated at the bottom of the user interface. Again, this is making use of python expressions (3.10); another expression within the Common tab of tile1 node turns the tiling on and off, based on the status of the Tile button within the interface.

![Python expressions in tile1](image)

**V - Deep Loop** is the same as Under Over loop, also having its opacity affected by the user with a range between 0.8 and 1 but instead of having its rotation set by the user, it’s at a constant of 100 degrees; the user is however capable of changing the x value of the grow-shrink factor, using the Depth button, values ranging from negative 800 to 0, offering a nice fractal-like effect. What’s special about this loop is that it comes after the Tile, so if Tile is turned on, Deep Loop is more effective. The effect perpetuated by this container can be switched on and off by pressing the Deep button within the interface.

![Node network inside VisualGenerator/Container1/DeepLoop container](image)
4.2.2 Audio Analysis Module

For a more in-depth audio analysis than the one provided by TD operators, I wanted to split the soundtrack into different channels (such as drums, guitar, and bass) without having to need a special audio file (that has those separate channels) so that such a feature would be accessible to any user. I figured out that it might be impossible to do with an mp3 file, only using touch designer. It is possible to do so using more sophisticated algorithms and programs, but they also require manual processing in order to get useful results [6], which takes up a lot of time and makes the interface less usable. Lastly, it wouldn’t work well with live audio input.

I could however analyse the audio input in a more abstract way, by measuring and splitting the frequencies along the timeline. For example, when the bass or the kick drum hits, a lower frequency raises its amplitude, and when a hi-hat or a snare does, a higher frequency does.

The container is called AudioAnaliser and it’s situated within the main folder (/project1). To do this analysis I took the audio input, split it into 3 different streams and applied low-pass filters on two of them and a high pass on the other. This way, I was able to get the low, mid and high frequencies on three separate channels and use them to change the visuals, making for a more effective interaction. The only drawback to this is that the variables of the filters must be changed with each different song from within TD.

The node network (4.1) features an Audio In operator taking whatever audio is inputted (a file, device or an online stream); this is split in three branches (Low, Mid and High, each of which has two channels). The top branch is connected to a low-pass Filter (4.2) which amplifies every sound that has a frequency below a certain value (for this song, ‘We Want Your Soul’, the value I found to work is 152 Hz). Then, an Audio Band EQ is applied, which again amplifies frequencies in a desired range and eliminates the rest. Then, an Envelope of type exponential decay is applied to the sound for
finer processing and Resample changes the sample rate and turns the input in numbers. After that, I combine the two audio channels into one by scaling and adding them (in Math), I filter the values so that they become smoother, Rename the channel into ‘low’ and merge it with the other two channels. Same idea is applied to all three branches, but with different values for Filter and Band EQ. Note that with every new song a different set of parameters must be entered.

4.2.3 Controls Module

As mentioned before, the interface can be either controlled via MIDI or MOUSE; MIDI on/off is a button on the interface which allows the user to choose his desired input. Configuring a MIDI device is not a trivial task (although not very difficult either). From MIDI device we send (through Null2) a MIDI channel to each button / slider container. Within these containers we make some decisions regarding. The same applies through all these containers.
To illustrate how these decisions are made, and how user inputs are referenced throughout the project, we will have a look at the Play Button container.

The SELECT node selects one of the midi channels (in this case the one named `start`); Math node scales the 1-127 input from midi to 0-1; since start is a button on the midi machine, its states can only be 0 or 1. Button > also outputs a value of 0 OR 1, depending on its state (off or on). Button > is situated on the GUI and is affected by the mouse. In the second Math node we don’t do any math, we just combine the two inputs. A Python expression within the Constant node selects whether we output the midi control or the button from the interface. The expression translates as: take the channel called ‘v1’ from operator ‘math33’ (the Button > input) if operator ‘../null2’ (situated in the parent folder, it is the MIDI on/off button output) is OFF (0); else take the channel ‘start’ from ‘math33’ (the MIDI input).

It is not trivial to connect a midi controller because the channels will have different names than the ones from my one (Korg electribe2), and therefore the user will need to go inside each button and slider container and change the Select node and make it choose the desired midi channel.
5 Future Work

So far in pursuing this project I managed to gain a better understanding of the field of New Media, of the relation between computer science and creative arts, I managed to develop a framework in the form of a Touch Designer plug-in which provides instruments for creating digital arts and steering them in real time, and I also used this framework to perform three live shows (final performance after the 1 week TD course, a performance at the Belconnen Arts Centre the following day, celebrating Belconnen’s Anniversary and a performance in the COMP1720/6720 Art and Interaction in New Media class).

What I haven’t done yet is to test how other people interact with this framework. After all this was a major point as it will offer me useful information in improving further iterations. I shall do so by uploading the plug-in on-line and observing people’s comments on it. If that doesn’t give me enough feedback, conducting a user study will be another option. Secondly, with the three performances and the other times that I have used it, I feel like I’ve reached its limits in terms of creative expression, so I would like to add more elements and themes in it. Thirdly, there are more ways to implement effective interactions when using code that just using nodes and one-line snippets, so I also plan to write Python algorithms to use in the future and, if I find it purposeful, add them to the existing libraries.

Another important topic that I haven’t covered is the audience input; future iterations will feature input devices that take data from the outside world and algorithms to process and transform that data in effective visualisations. I would like the user to interact with the program in different, more involved ways, rather than only with a MIDI or mouse, so I will further develop the Controls module to accept more inputs and keep it in such a way that it may also be used in other projects too.

The audio analyser is mostly complete and can be easily adapted by the experienced TD user to any audio input; however the novice user might have a hard time doing so. I plan to add a few different interactive elements (buttons, sliders) to help this type of user gain the desired effect from this tool in a short amount of time. Maybe a script to analyse the song automate this process can be even more useful.

Even though this artefact covers a few concepts related to manipulation of digital imageries, it is not enough to help one grasp the basics and to use them in other ways. It’s more an illustration tool rather than a learning tool. In another plug-in I would like to concentrate on basic concepts and to illustrate them using simple visualisations, in doing so allowing the user freedom to choose how to combine these concepts, instead of putting my own ideas to use.
6 Impact of New Media in the World

Awareness of the changes are what McLuhan seemed to consider most important, so that, in his estimation, the only sure disaster would be a society not perceiving a technology's effects on their world, especially the chasms and tensions between generations.25

Through my journey of exploring and understanding this field, I came to the conclusion that essentially, New Media is just another tool; a very powerful, widely accessible tool that connects a large number of people and is not under the control of a separate entity (such as Old Media, influenced by the share holders). Therefore, I consider that what matters most when using it is the intention that one has. Like any other tool, New Media and the Internet can be used in ways that can negatively affect people (cyber-bullying, pornography, information theft) or it can be used for positive purposes (teaching, learning hobbies and activities, sharing meaningful information, creating arts).

Every person has access to the web has the ability to change it and to be changed by it; the creator is influenced by what he created, and what he'll create from now on is going to be affected by what he's done thus far; in a way, New Media acts as a perpetuum-mobile, an instrument that perpetually generates output based on what was generated in the previous instance. As our actions shape the outside world, the architectures of our cities, the way we eat our food or the music that we listen to, our environments shape how we think, act and feel; the actions we perform and thoughts that we have become who we are.

I consider that New Media is the most trivial example for the interconnectivity that exists between people. Since ideas take only an instance to travel from one part of the world to another, I consider New Media to be the 21st century’s platform for human connection and interaction. It definitely widened our perspectives on many different aspects, such as providing new ways of visualising data and understanding science, making us aware of many cultures and habits around the world and giving us instant access to any desired piece of information. From communication to the masses to communication between people, from suppressed and censored information to shared and free knowledge and from exclusive artworks to art created by and shared amongst many, New Media had a big impact in the world and will continue to do so, at least for the next few years (Augmented Reality is slowly but surely reaching mainstream).

Steering is a big part of the New Media artistic practices as it allows for the momentary inspiration to be expressed and it brings the human element in the present moment instead of leaving it as a past entity that created an artwork; in doing so, the piece of art is ever-changing, in a way never reaching a destination, illustrating again that the journey is more important, as there is no destination.

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25 Taken from https://en.wikipedia.org/wiki/Understanding_Media
7 Conclusion

In this paper I have offered historical information on New Media and New Media Arts, followed by current issues in this field; I have given examples on how this artistic practice dissolves the borders between humans and technology, illustrated my journey while learning a software that aided in creating a framework for the Live Steering of New Media Arts, offered details about the technical implementation of it, given artistic explanations for a performance that I did using this framework and discussed the effects that Live Steering has in New Media Arts and how the world has been changed by New Media.

References
Can be read here, on page 12: http://www.churchandnewmedia.com/wp-content/TheChurchandNewMediaSample.pdf
Can be found here: http://faculty.georgetown.edu/irvinem/theory/manovich-new-media-intro.pdf
Can be read here: http://faculty.georgetown.edu/irvinem/theory/manovich-new-media-intro.pdf

Appendix 1 - Final Project Description

As agreed upon in the Independent Study Contract, the Final Project Description states that:

“Tudor plans to create software that will automatically extract channels from a live musical performance so that they can be visualised independently and mixed together with live visuals of the performance itself. This whole process will be able to be steered in real-time and it maybe collaborative with other artists.”
INDEPENDENT STUDY CONTRACT

Note: Enrolment is subject to approval by the projects co-ordinator

SECTION A (Students and Supervisors)

UnitID: ______5553428__________
Surname: __Barlow__; _______ First Names: ______ Tudor _______
Project supervisor (may be external): _______ Henry Gardner ___________
Course supervisor (e.4870 academic): _______ Henry Gardner ___________

Course code, title and unit: __COMP3710__ Topics in Computer Science
Semester: $$ S1 $$ $$ S2 $$ Year: ___2015_____

Project title:
Live Steering of Media Arts Performance

Learning objectives:
a) Understanding of research and artistic practice in live coding and new media arts
b) Ability to construct software to steer live computer graphics to accompany artistic performance

Project description:
Tudor plans to write software that will automatically extract channels from a live musical performance so that they can be visualised independently and mixed together with live visuals of the performance itself

This whole process will be able to be steered in real-time and it may be collaborative with other artists.
<table>
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<tr>
<th>Assessed project components:</th>
<th>% of mark</th>
<th>Due date</th>
<th>Evaluated by:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Project Presentation Report</td>
<td>0 %</td>
<td>Fri 20/08/2015</td>
<td>Ben Swift</td>
</tr>
<tr>
<td>(e.g. research report, software description...)</td>
<td>50 %</td>
<td>Fri 30/10/2015</td>
<td>Ben Swift</td>
</tr>
<tr>
<td>Artifact: name kind: <em>Code</em> (with UI) + Performance Video of performance (e.g. software, user interface, robot...)</td>
<td>40 %</td>
<td>Fri 30/10/2015</td>
<td>Henry Gardner</td>
</tr>
<tr>
<td>Oral Presentation: (with cohort of students)</td>
<td>10 %</td>
<td>Thu 22/10/2015</td>
<td>Henry Gardner</td>
</tr>
</tbody>
</table>

MEETING DATES (IF KNOWN): Wednesdays 10:30 am, weekly

STUDENT DECLARATION: I agree to fulfill the above defined contract:

.............................................. Date

SECTION B (Supervisor):
I am willing to supervise and support this project. I have checked the student's academic record and believe this student can complete the project.

.............................................. Date

REQUIRED DEPARTMENT RESOURCES:

SECTION C (Course coordinator approval)

.............................................. Date

SECTION D (Projects coordinator approval)

.............................................. Date

Research School of Computer Science

Form updated Jan.
Appendix 3 – Artefact Description

This artefact consists of a .toe file (Touch Designer plug-in), named FinalArtefact.

Opening this file from within Touch Designer, you will see 3 black containers:

- CONTROLS (original)
- VisualGenerator (original)
- AudioAnalyser (inspired by Matthew Reagan)²⁶

A purple node moviefilen1 which takes in an image file and
A green audiofilein1 which takes in an audio file;
Audiodevout1 (green) outputs the audio;
AudioChan (green) is what’s generated by the AudioAnalyser.
Out1 (purple) outputs what’s created by VisualGenerator
Projector.

²⁶ https://www.youtube.com/watch?v=K7fRKMCBnd0
Appendix 4 – Images Generated Using ‘Kaleido-Utopia’