MSc Electronic and Electrical Engineering

Sustainable Technologies MOD003297

Assignment 2 Presentation

Sustainability and Music Technology

Focus

This report/presentation will focus on data and hardware sustainability in the music technology environment. These issues effect both technical and aesthetic aspects of the activity and, for this reason, there is less emphasis on the ecologically sustainable parts of the technology. So, instead, focusing on the ecosystem comprising:

- data preservation
- software preservation
- hardware preservation

Vint Cerf: Digital Vellum

https://www.youtube.com/watch?v=GV0A82TCrf0

Interesting talk from March 2014 containing nothing in itself hugely consequential, but thinking each issue through carefully and trying to envisage full solutions. Should we worry that our aesthetic efforts using technology might become obsolete and unreachable within a few years, or is this just an inevitability? Finally, even bearing in mind the solution suggested at about 11:00 in the video, can/would this work with critical systems that require (currently) very high performance and could not (currently) operate under virtualisation?

- 1:13 – preserving writings
- 1:48 – obsolete technology
- 2:25 – how to correctly interpret the bits (one version of bit rot)
- 3:30 – software that knows what the bits mean
- 3:45 – we have devices to store bits but we don't/won't know what they mean...
- 4:45 – book about lincoln
- 6:40 – "a forgotten generation"
- 7:30 – preserving ecosystems
- 8:08 – Windows 3000
- 8:55 – games, consoles, etc...
- 9:30 – solution: cloud-like systems
- 10:00 – proprietary systems...
- 11:15 – full ecosystem...

IRCAM, Boulez, Repons...

Another example: the 1980 composition *Repons* by the French composer Pierre Boulez: one of the first 'professional' pieces to include live electronic responses during performance using the *Sogitec 4X* computer specifically designed for this use (it could generate 1000 sine waves simultaneously).

- Computer storage room at IRCAM
- Compare to authentic performances
- Compare "authenticity vs precision" to "accuracy vs precision"

http://articles.ircam.fr/textes/Boulez88c/

British Library

- Strategy: https://www.bl.uk/digital-preservation/strategy#
- Document: https://www.bl.uk/britishlibrary/~/media/bl/global/digital%20preservation/bl*digitalpreservationstrategy*2017-2020.pdf

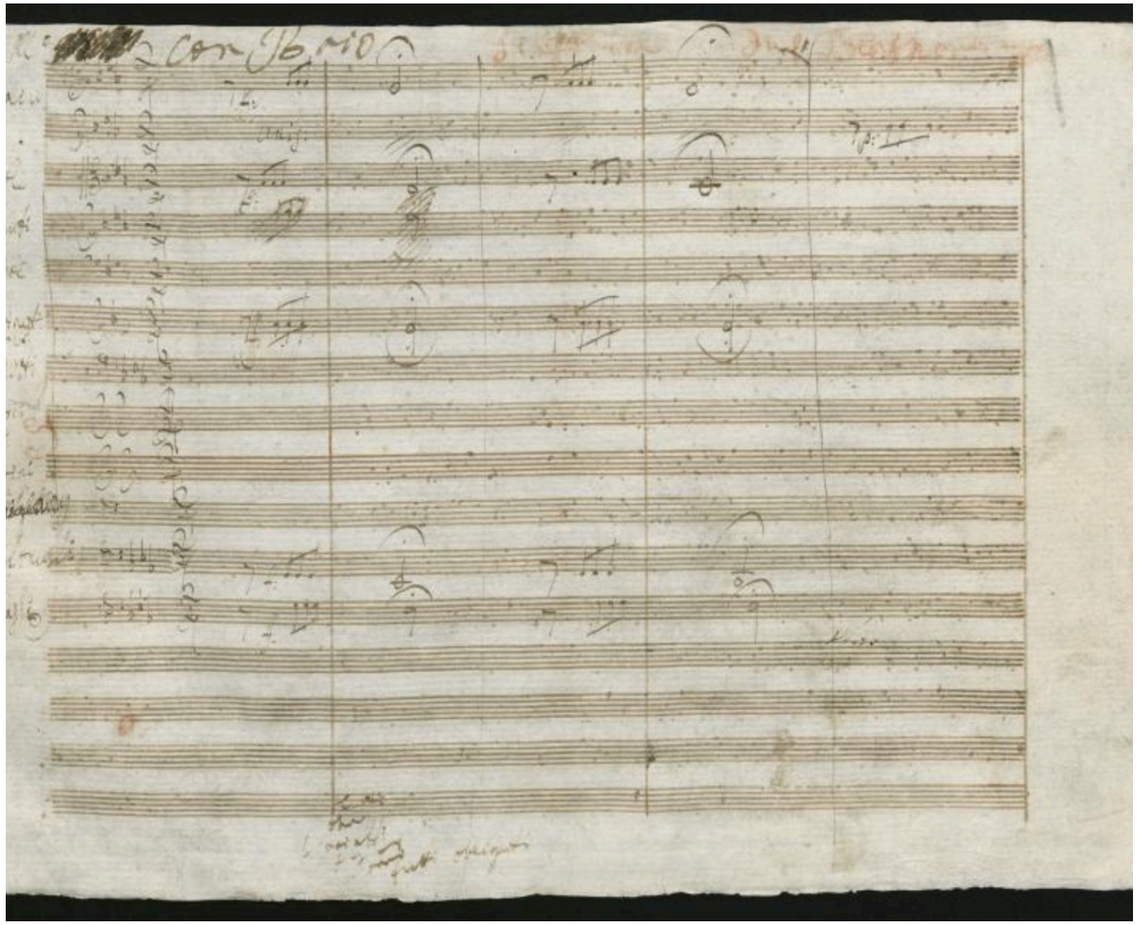
British Library

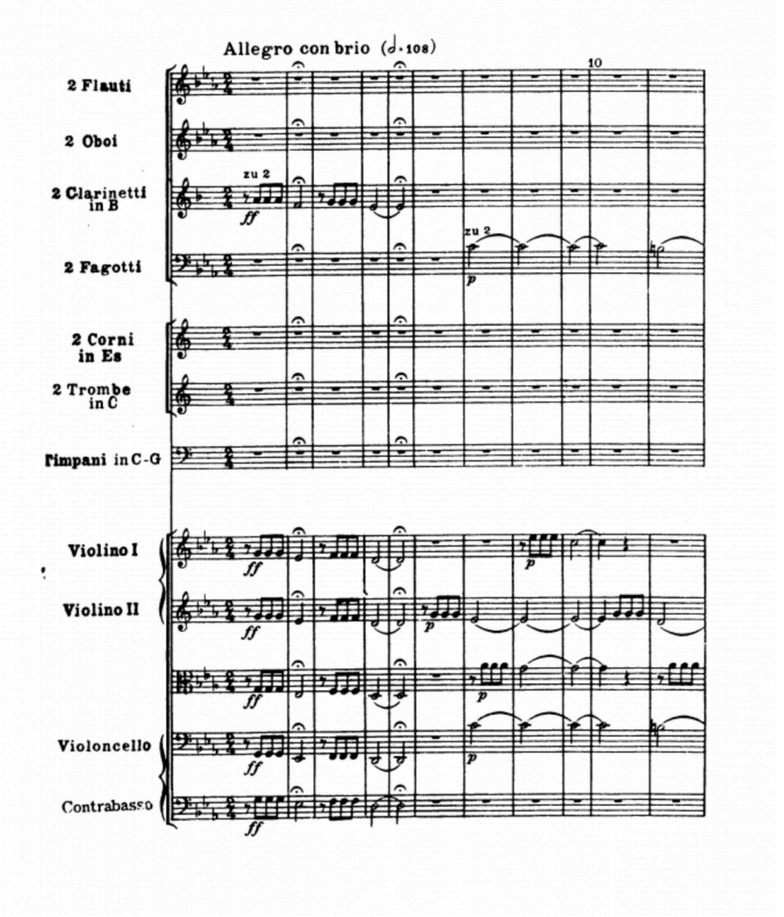
"Technological obsolescence is often regarded as the greatest threat to digital material: as technology changes, it is increasingly difficult to reliably access content created on and intended to be accessed on older computing platforms. Yet this is just the long term view: in the shorter term we must also consider everything from media integrity and bit rot to digital rights management and metadata.
Other notable differences between analogue and digital content further add to the challenge:

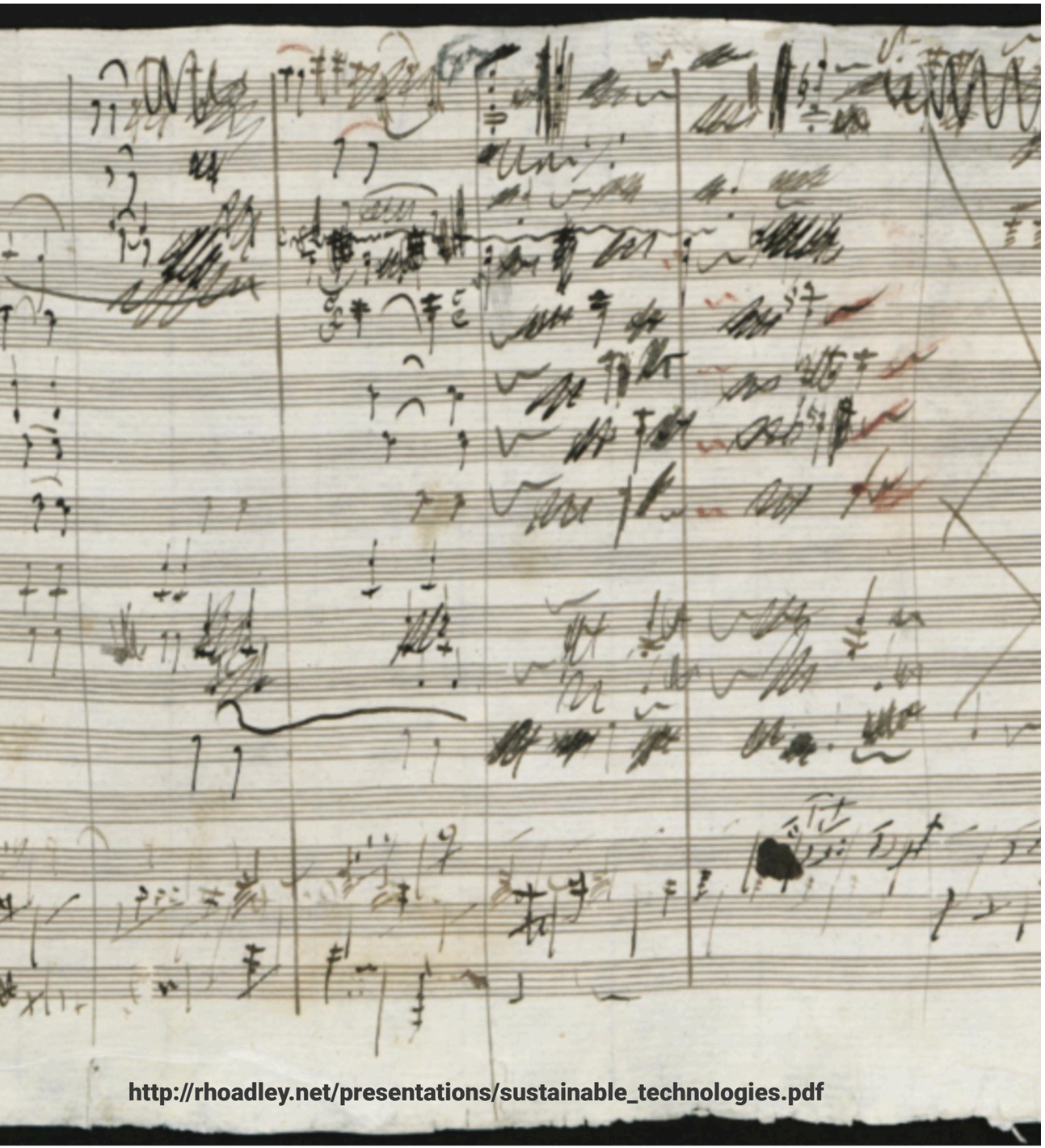
- Proactive Lifecycle management: Ongoing technological advances and the fragility of digital content require preservation actions to be taken much earlier in the lifecycle than for traditional collections, and at a much greater frequency. A lifecycle management approach is needed to ensure appropriate actions are taken in good time;
- Integrity & validation: It is easier to make unnoticed changes to digital content than to traditional objects, changes which may affect the authenticity and integrity of the content. Malicious change must be prevented and appropriate change managed;
- Fragility of storage media: The integrity of storage media for digital materials diminishes at a more rapid pace than analogue archival storage. Resulting bit rot can prevent files from rendering correctly if at all; this can happen with no notice and within just a few years, sometimes less, of the media being produced.

"Digital preservation is thus not simply a technical challenge. It necessitates an ongoing and typically recursive series of actions and interventions throughout the lifecycle to ensure continued & reliable access to authentic digital objects, for as long as they are deemed to be of value."

Example: Beethoven score: a lack of precision?







The copyist's and editor's role was very much more involved than that of digital curators!

See full Beethoven autograph here: https://digital.staatsbibliothek-berlin.de/werkansicht?PPN=PPN664344127&PHYSID=PHYS*0001&DMDID=DMDLOG*0001

Music as Technology

- Music is a significantly, even *predominantly* technological activity.
- Instrumental performance is similar to sport, in that it involves complete synergy with a physical object (even if that physical object is one's own body).
- Some musicians as examples:

Jamie Cullum (BBC Radio 4 Desert Island Discs)

Midori Goto

Nicola Benedetti

Jimi Hendrix Live at Woodstock

- 1:30: 'vocalising'

Work with Kinect (etc.)

- seeks to exploit physical expression and translate it into music/performance/notation
- allows unimpeded free movement by dancers without wires or other add-ons
- does not require a specialised studio or set of cameras
- however, does not allow completely unimpeded view
- also, it is not as accurate as manual, physical controls

https://www.youtube.com/watch?v=DquDZq-7-Eg#t=15

also 2:30

Kinect 360/One is now obsolete - why did it fail?

2011 promotional video: https://www.youtube.com/watch?v=RN_zu3xVQ5M

- "Kinect failed because it sucks. Nobody wants to jump around like an idiot to play games and nobody likes talking to their TV."
  https://www.gamespot.com/forums/system-wars-314159282/one-simple-reason-why-kinect-failed-31261682/?page=2
- "In my apartment, playing a Kinect game requires moving furniture around to give the sensor the field of view that it needs to work well. It's a big problem for lots of gamers, since you need 6 to 10 feet between you and the sensor.
- "Try playing that in a dorm room or small apartment."
- "their existing, lucrative, big-budget franchises [already] work frighteningly well with a traditional controller"
  http://uk.businessinsider.com/why-microsoft-xbox-kinect-didnt-take-off-2015-9?r=US&IR=T

...and what about the irony that the (badly acted) music 'performances' in this video are actually 'played' by electronic instruments...

http://rhoadley.net/presentations/sustainable_technologies.pdf

But...

The Kinect has found a strange second life outside gaming.

- "Its nifty motion-tracking tech has a ton of other applications. In 2010, Adafruit CEO Limor Fried released a set of unofficial drivers to make the Kinect for Xbox 360 work with Windows — which allegedly annoyed Microsoft at first, but they came around and released an official version down the line.
- "From there, artists and robotics hobbyists started working the Kinect into all kinds of projects..."
  https://www.businessinsider.com.au/why-microsoft-xbox-kinect-didnt-take-off-2015-9

Consequences?

- How much resource and reliance should anyone place in technology that they little or no control over?
- How much control is really control?
- I wouldn't expect to be able to make a piano, but I think they'll be made for some time to come. Acoustic instruments have faded and disappeared (e.g. bassett horn, viol), but in general this takes a long time so practitioners have time to adapt.
- To an extent this is true of the Kinect as well (there are quite a few alternatives), but because they are from different manufacturers it means quite a lot of work to 'translate' material from one piece of hardware to another.

Alternatives?

- Alternatives to Kinect: Intel Realsense
- Developmented from Kinect: Microsoft Hololens
- Further irritants: obolescence of non-c usb ports (will adaptors work?)
- All require hardware/software/firmware changes and upgrades. Eventually they will not work at all. What then?

Solutions:

Universal, accepted standards (e.g. usb?!). However, in music this means everyone accepting these standards. In any creative area it is often a given that 'standards' should be 'broken' as a part of that creativity.

Some standards:

MIDI

1983 tech that is principally unchanged since. It implements a particular (and particularly stylistically biased) set of 'standards'. In some respects can be seen as 'holding back' music tech development, but can also be seen as successful in providing at least one or some standards, so most current MIDI instruments are really plug and play. Very outdated, based on a time when playing an eight note chord over a DIN connection would result in clear latency from the target instrument. 0-127, or even 0-255 is simply not high enough resolution for many sophisticated musical purposes.

Channel Voice Messages [nnnn = 0-15 (MIDI Channel Number 1-16)]

Header 1	Header 2	Header 3
1000nnnn	0kkkkkkk; 0vvvvvvv	*Note Off event.* This message is sent when a note is released (ended). (kkkkkkk) is the key (note) number. (vvvvvvv) is the velocity.
1001nnnn	0kkkkkkk; 0vvvvvvv	*CNote On event.* This message is sent when a note is depressed (start). (kkkkkkk) is the key (note) number. (vvvvvvv) is the velocity.
1010nnnn	0kkkkkkk; 0vvvvvvv	*Polyphonic Key Pressure (Aftertouch).* This message is most often sent by pressing down on the key after it "bottoms out". (kkkkkkk) is the key (note) number. (vvvvvvv) is the pressure value.

And so on...

Very grid like, assumes similar pitch structures (MIDI note values 1-127) rather than frequencies, (relying on manufacturers to implement solutions via System Exclusive messages). Musically this can be an advantage, but it is also restrictive and stylistically biased.

https://www.midi.org/specifications

HID (Human Interface Device)

A selection of HID messages (from a Logictech 'Rumblepad' via SuperCollider)

```
[ element, 0, 1, 1, 1, 0, 3, 9, 2 ]
[ element, 0, 0, 0, 0, 0, 3, 9, 2 ]
[ element, 0, 1, 1, 1, 0, 4, 9, 3 ]
[ element, 0, 0, 0, 0, 0, 4, 9, 3 ]
[ element, 0, 1, 1, 1, 0, 1, 9, 0 ]
[ element, 0, 0, 0, 0, 0, 1, 9, 0 ]
[ element, 0, 1, 1, 1, 0, 2, 9, 1 ]
[ element, 0, 0, 0, 0, 0, 2, 9, 1 ]
[ element, 0, 0.48235294222832, 123, 123, 0, 53, 1, 16 ]
[ element, 0, 0.4745098054409, 121, 121, 0, 53, 1, 16 ]
[ element, 0, 0.46666666865349, 119, 119, 0, 53, 1, 16 ]
[ element, 0, 0.46274510025978, 118, 118, 0, 53, 1, 16 ]
[ element, 0, 0.4745098054409, 121, 121, 0, 53, 1, 16 ]
[ element, 0, 0.46274510025978, 118, 118, 0, 53, 1, 16 ]
```

OSC (Open Sound Control)

Open Sound Control (OSC) is a protocol for communication among computers, sound synthesizers, and other multimedia devices that is optimized for modern networking technology. Bringing the benefits of modern networking technology to the world of electronic musical instruments, OSC's advantages include interoperability, accuracy, flexibility, and enhanced organization and documentation.

This simple yet powerful protocol provides everything needed for real-time control of sound and other media processing while remaining flexible and easy to implement.

Features:
+ Open-ended, dynamic, URL-style symbolic naming scheme
+ Symbolic and high-resolution numeric argument data
+ Pattern matching language to specify multiple recipients of a single message
+ High resolution time tags
+ "Bundles" of messages whose effects must occur simultaneously
+ Query system to dynamically find out the capabilities of an OSC server and get documentation

http://opensoundcontrol.org

```
/* design the synth on the server */

(
SynthDef("fm1", {
    arg bus = 0, freq = 440, carPartial = 1, modPartial = 1, index = 3, mul = 0.05,
    myAmp=0.2, dur=1.0, attack=0.05, sust=0.1, release=0.8,
    pan=0.0, panx=0.0, pany=0.0,
    outBus = 0, effectBus, direct = 0.5;

    var source, sourceDry, sourceWet, mod, car, env;

    mod = SinOsc.ar(
        freq * modPartial,
        0,
        freq * index * LFNoise1.kr(5.reciprocal).abs
    );

    car = SinOsc.ar(
        (freq * carPartial) + mod,
        0,
        mul
    );

    env = EnvGen.kr(Env.linen(dur*attack, dur*sust, dur*release, myAmp), myAmp, doneAction: 2);
    source = car * env;

    if ( ~panSetup == 2, {
        sourceDry = Pan2.ar( source * direct, pan, 0.3);
        sourceWet = Pan2.ar( source * (1 - direct), pan, 0.3);
        }, {
        sourceDry = Pan4.ar( source * direct, panx, pany, 0.3);
        sourceWet = Pan4.ar( source * (1 - direct), panx, pany, 0.3);
    });

    Out.ar(outBus, sourceDry);
    Out.ar(effectBus, sourceWet);

}).send(s);
)
```

```
\* and play it by send messages from your software of choice to the server using OSC *\

Synth("fm1", [ \freq, 440, \carPartial, 1, \modPartial, 2.4, \myAmp, 0.5, \panx, -1.0, \pany, 0.0, \effectBus, ~effect ]);

Also see, Sonic Pi, HaskellCollider, etc...
```

SMUFL

https://www.smufl.org

An attempt to standardise music notation. As usual, many discussions are about standards vs freedoms...

Conclusions

- All forms of standardisation are by definition restrictive, but have the advantage that it is easier to implement and connect things.
- Music is particularly vulnerable to this due to its stylistic variation and abstract nature.
- Performing musicians commonly spend a very significant part of their lives becoming acquainted with and then practicing a single, usually complex, but finite piece of hardware. This hardware is limited, but commonly available. It differs between cultures, but most cultures have these artifacts. These artifacts are the 'standardised' part. What is done with them has been the subject of constant experimentation (e.g. Beethoven 'Moonlight' and Cage 'Prepared piano').
- Until now, electronic and digital technologies have sought to *copy* these instruments, but as they are usually to an extent, infinite (i.e. synthesisers) it is not possible to 'learn' them in the same way that we might 'learn' a piano, for instance.
- However, it is possible to use them to compose and perform with sufficient individual attention (i.e. little standardisation).
- But what happens when the technologies on them become obselete?