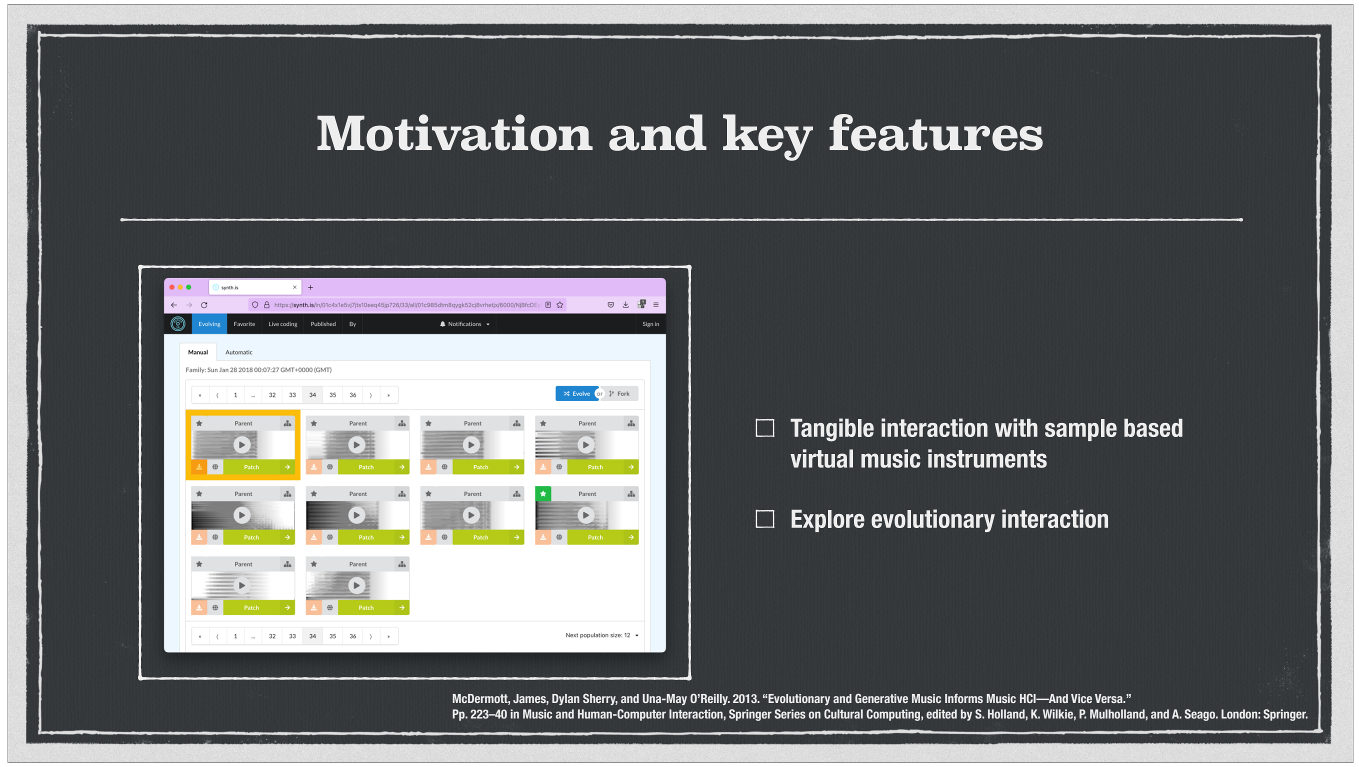
Robiohead

New Interface for Sound Evolution (NISE)



The interactive music system I set out to design and implement, is an attempt to explore physical, or even embodied, interactions with sample based virtual music instruments.

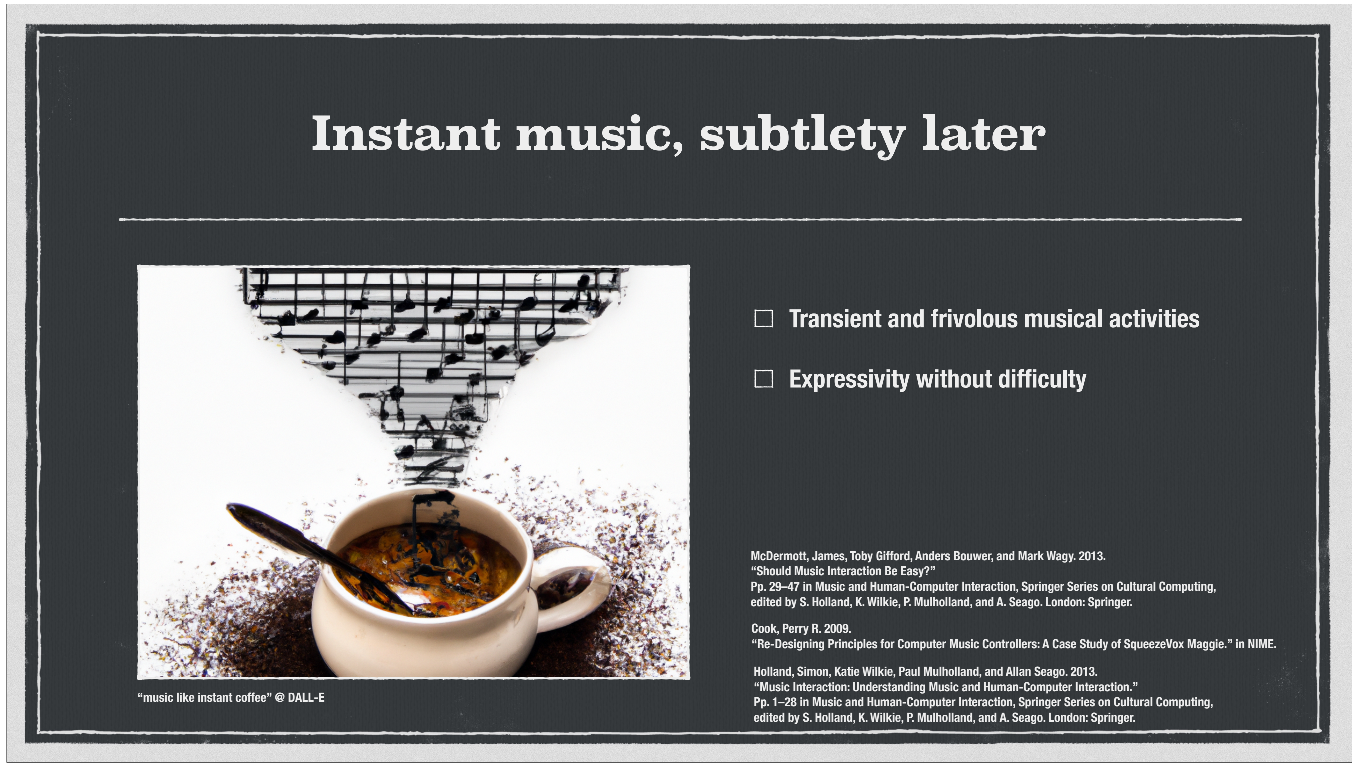
Those sample based instruments come from an evolutionary system where sound genes can be mutated and paired, to discover new sounds.
There is a web interface, where individual sounds can be selected as parents for future generations, and sounds from automated evolutionary processes can be curated with mouse clicks.

The design of the instrument is also intended to explore alternative interactions for evolving sounds with such a system. So the design attempts to offer one possible solution to evolutionary interface problems.

A design premise is that the IMS is as much a toy, as a musical instrument.

The instrument should at least encourage playfulness. It should be discovered within the context of playful activities,
where toys are instruments for playing.

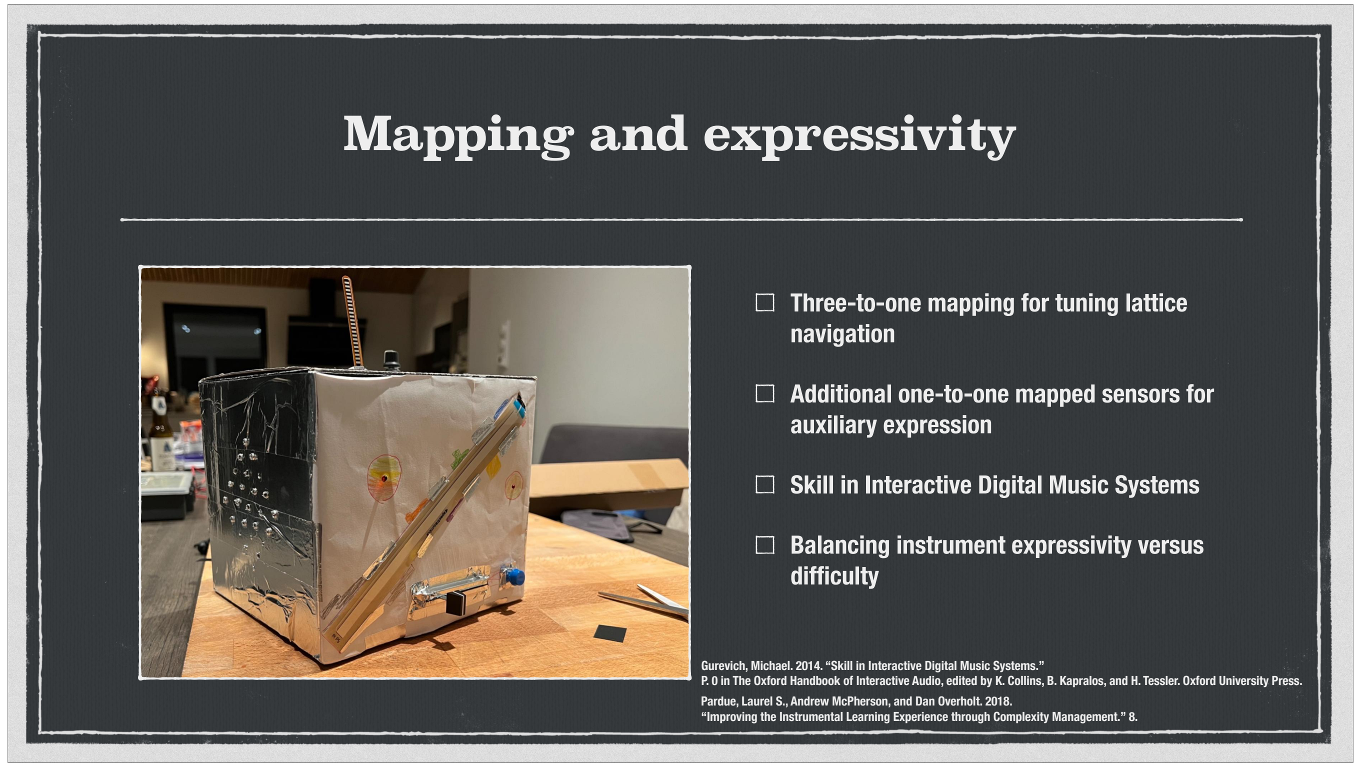
and while this IMS is debatably created as a “toy”, then the design aims at being playful, catering to the playful attitude of humans, which are able to toy around with most objects.



As the instrument is intended to encourage musical activities that are transient and frivolous,
allowing some expressivity without difficulty, as (McDermott and Gifford, et al. 2013) discuss,
then it is important that it makes sound immediately, simply and reliably,
adhering to the "instant music, subtlety later" principle for designing computer music controllers (Cook 2009).

While the IMS aims to, not discourage beginners and reward effort it should also remain non-trivial indefinitely (McDermott, Gifford, et al. 2013),
- so, not too easy
it should allow frivolous musical activities while also offering increased difficulty with more control.
Quoting Holland: One way is to enable "beginners to carry out harmonic tasks in composition [and] performance … relatively easily" where "tonal harmony is a demanding area of music theory, and harmonic concepts can be difficult to learn, particularly for those who do not play an instrument." (Holland et al. 2013).

And that applies to me.



The main relationship between mapping and expressivity in the instrument lies in a three-to-one relationship between sensors that affect the selection of samples in the virtual instrument:

- a gyroscope controls the position within a tuning lattice, discussed later
- a sliding potentiometer controls the duration of the samples
- and a soft membrane potentiometer controls the shape of chords - also more on that later

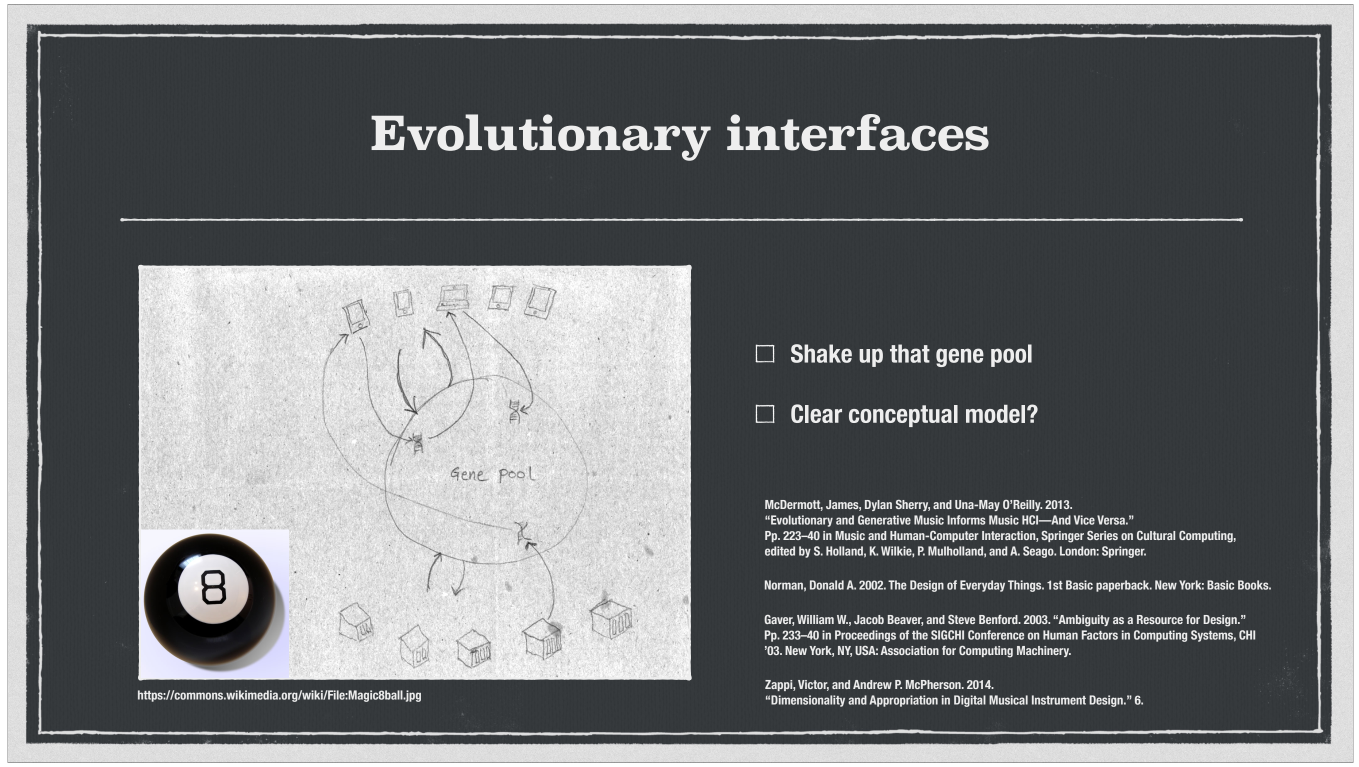
In addition, there is a flex sensor for controlling the filtering of the played sounds;
another consideration was to allow that sensor to control the instrument velocity, which was abandoned for this iteration.

A button allows the sample playback to be muted, to be able to navigate to new positions within the tuning lattice silently - where silence is an important part of music.

Even though a core design goal is to promote easy melodic playability, a parallel design premise is to, quoting Gurevich: “... support attainment of increasingly complex or desirable goals through sustained practice” (Gurevich 2014), by offering a mapping between gesture and sound which, while easy to begin exploring, will at the same time offer further exploration of nuanced interaction, where variations in the intensity of interaction produce different sonic results. This will require the management of complexity by “balancing instrument expressivity versus difficulty”, as discussed by (Pardue, McPherson, and Overholt 2018):

Interaction attributes, that may require practice to master, include

- the different speeds at which the instrument can be rolled to attain different outputs,
- finding and maintaining the desired position within the tuning lattice while rotating
- and pressing and holding a button for pausing the sonic navigation, for silent arrival at discontinuous lattice locations

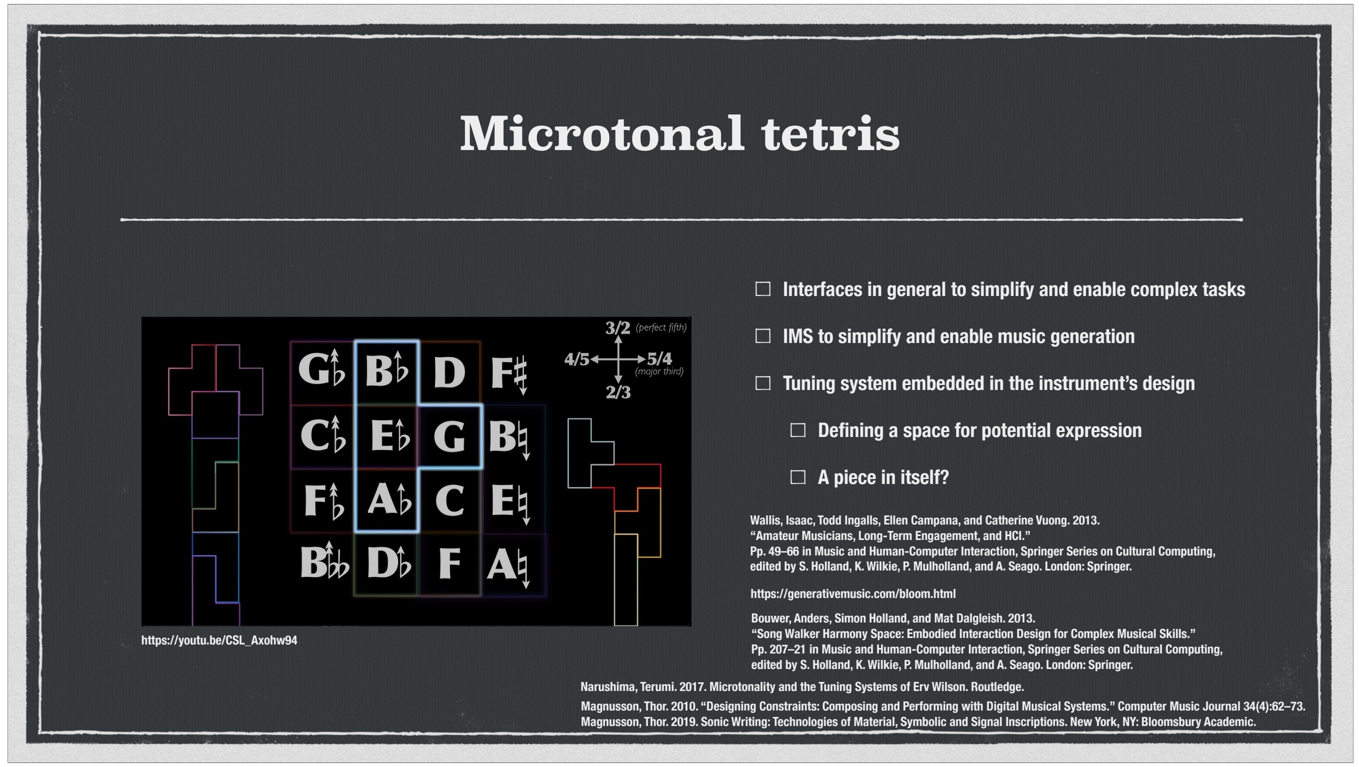


The design explores the value of ambiguity, as discussed by (Gaver, Beaver, and Benford 2003), by containing hidden affordances, which are discussed by (Zappi and McPherson 2014)
- which are here in the form of a shaking gesture, to discover new sounds.

Those will increase the difficulty of discovering all aspects of the interaction while also attempting to offer one possible “embodied interaction”-solution to the evolutionary interface problems, discussed in a chapter on evolutionary interfaces and the interplay with HCI, in the Music and HCI book.

This possibly desirable ambiguity and difficulty is interesting to compare to the more general design advice, to provide a good conceptual model (Norman 2002, ch. 1), which the book “The Design of Everyday Things” preaches.

Initial iteration of the interaction will not offer actual evolution of genes, with sonic-phenotype expression, but rather selection within a predefined set of sample based instruments. This can be viewed as interacting with a Magic 8 Ball.

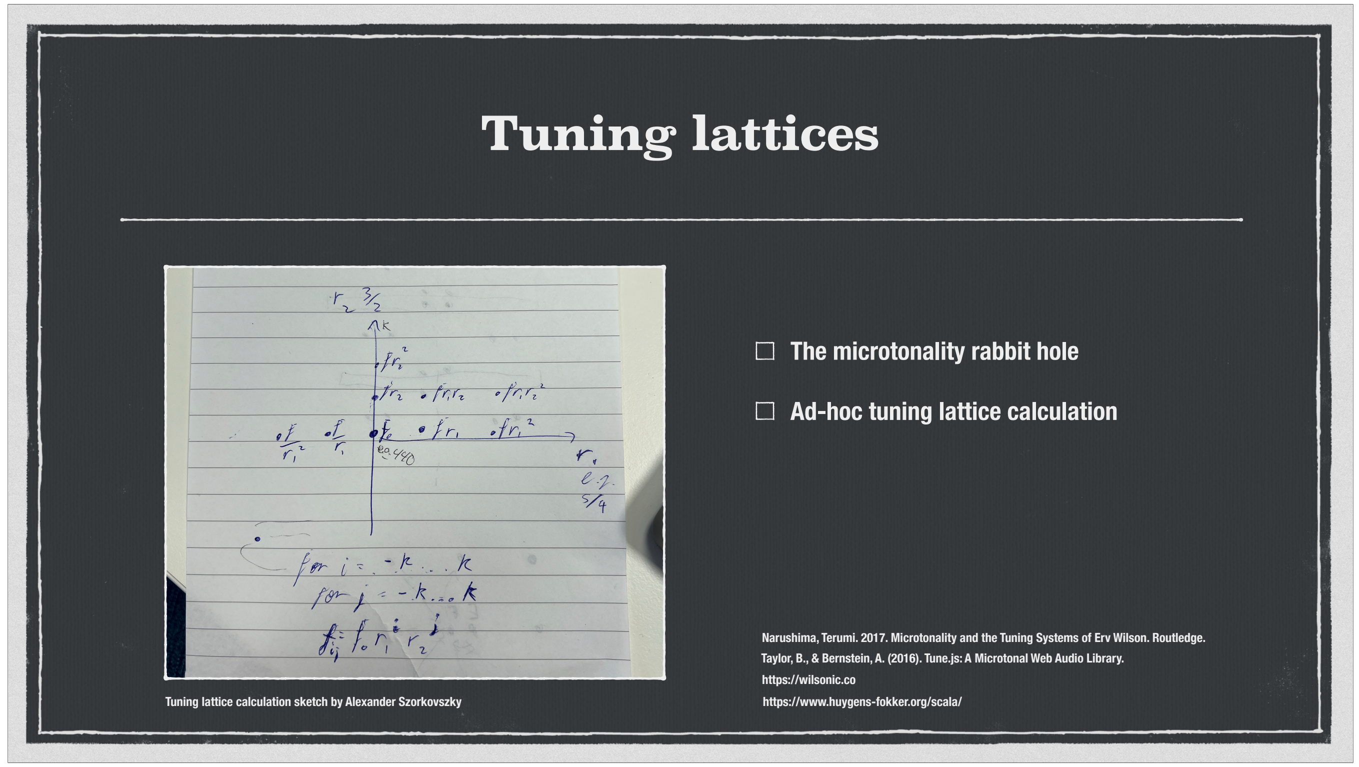


Just as interfaces in general can be designed to "simplify and enable a variety of complex tasks,
instruments exist to simplify and enable the act of music generation", which (Wallis et al. 2013) discusses.
One approach is to map gestures to scales, to avoid perceivably wrong notes, like (Brian Eno and Chilvers 2009) offer with the app "Bloom",
another is the spatial mapping used by the Harmony Space project (Bouwer, Holland, and Dalgleish 2013).

When I was considering how to navigate notes within sample based instruments, with this IMS,
Alexander Szorkovszky sent me a link to a YouTube video showcasing a piece with microtonal Tetris, where tetrionomes play chords within a tuning lattice. When seeing this video, I almost immediately decided that I would want to implement some interaction with a tuning lattice like this.

The two dimensional mapping of pitches used by the Hex Player (Milne et al. 2011) and Hex (Prechtl 2012) is close to the approach used by Robiohed,
where the interaction offers sonic navigation of the tuning lattices, which are extensively discussed by (Narushima 2017, ch. 6).

This "tuning system embedded in the instrument's design" (McDermott, Gifford, et al. 2013) will represent the main design constraint of the system, defining a space for potential expression (Magnusson 2010).
At the same time this embedding can make the instrument a vehicle of theory, becoming a piece in itself (Magnusson 2019, ch. 14), as Magnusson puts it in Sonic Writing.

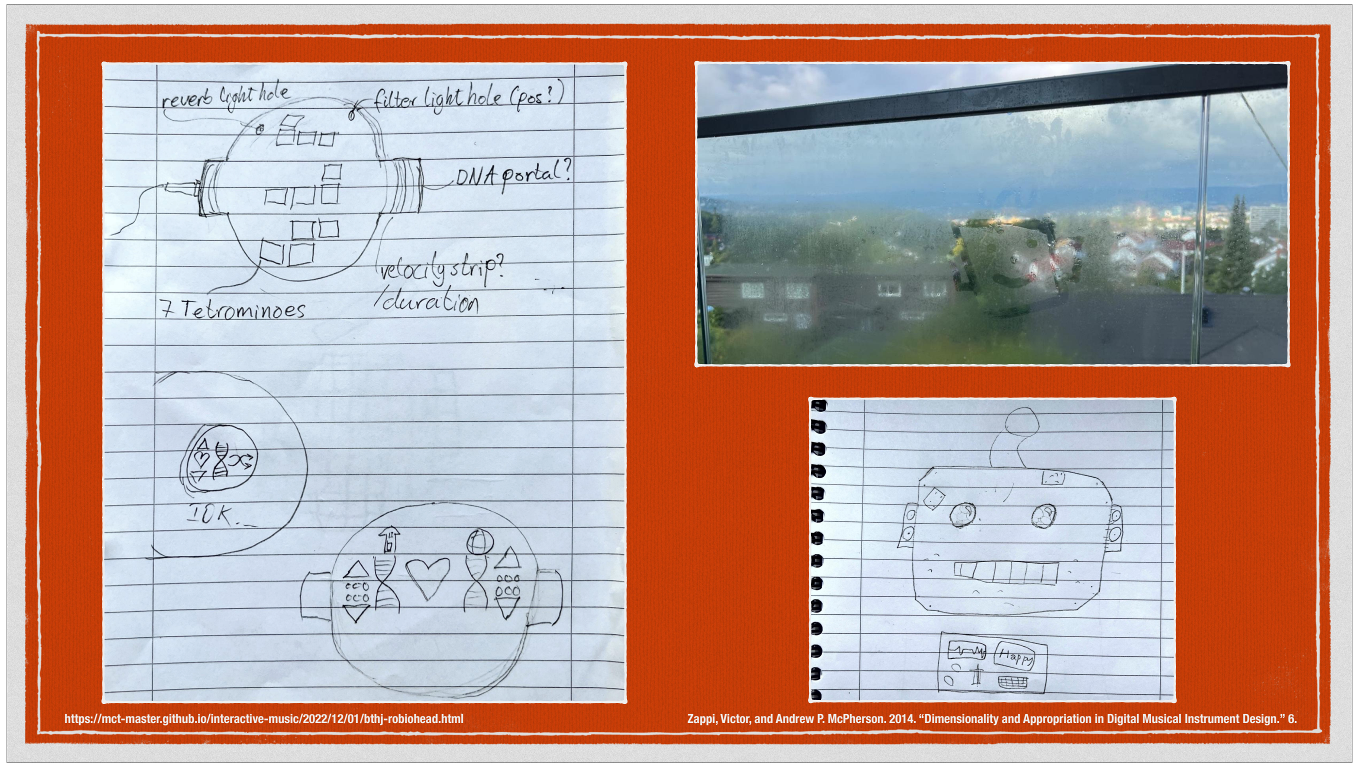


I've been interested in microtonality for a while. That has led me to look at the work of Erv Wilson, which has been in part implemented in the mobile app Wilsonic. The Scala tuning archive is also interesting and derived projects, like Tune.js.

But a straightforward, bespoke way of calculating the frequencies for a tuning lattice, like the one in that video, was somehow not obvious to me.
So I asked Alex if he could show me a simple way, which he quickly did, as we can see on this sketch.

With that, I implemented a bespoke tuning lattice rendering function,

within the synth.is project.



The initial idea for the overall design of the IMS was simply based on a sphere with short embedded cylinders sticking out from the two adjacent sides. The cylinders would offer connectivity and support for mounting the IMS.

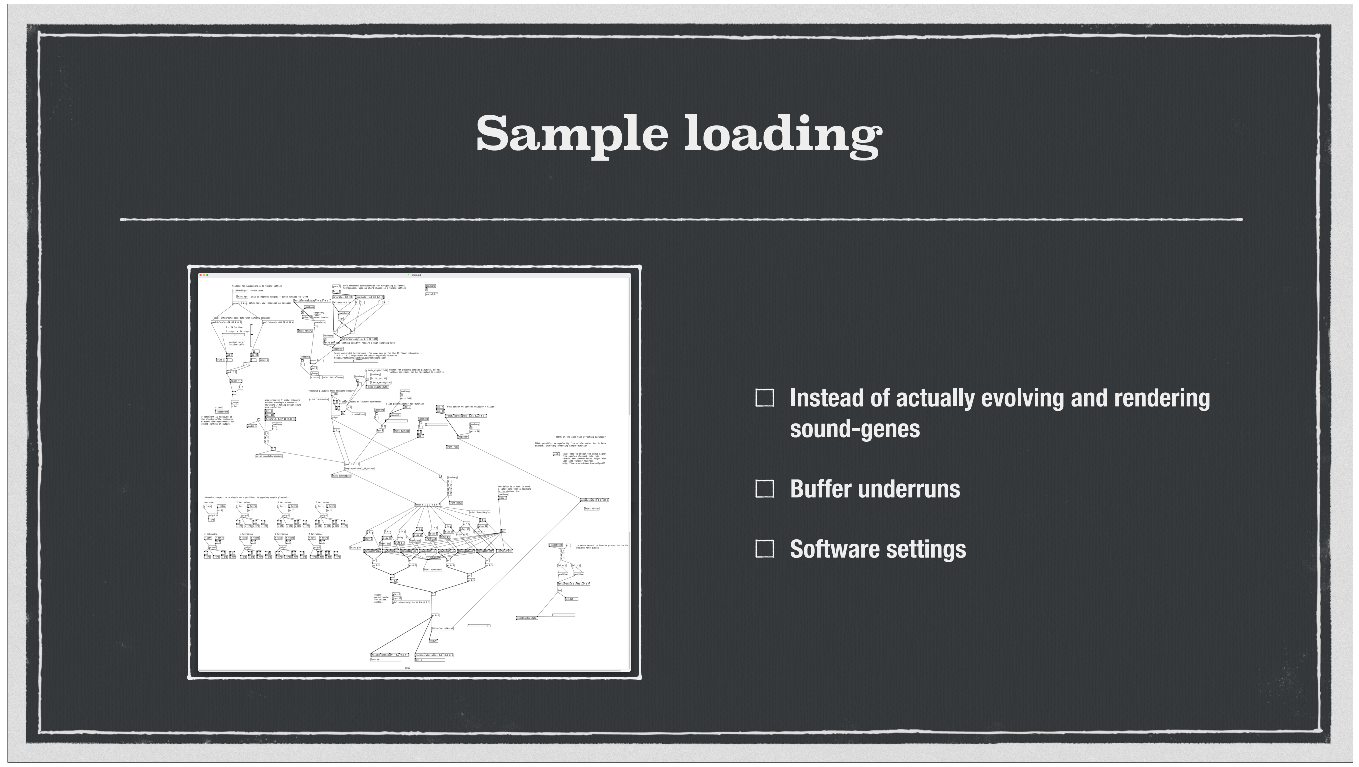
With that sphere-based design in mind, observing a robot head drawn by a nine-year-old on a misty glass, lead me to consider that form as a basis for the IMS design: It may offer the desired invitation to play and discovery, as it looks intriguing and a bit playful. The box shape is also easier to work with than a sphere, for an early prototype: So I decided not to think outside the box, for this iteration.

The nine-year-old was quick to sketch out the ideas, as we can see one example of here.

The evolutionary interactions, mapped to buttons in the initial concept iteration,
are for now simply mapped to an accelerometer,
for detecting gene-pool-shaking gestures:

In addition to the previously discussed sensors,
there are LEDs in the yes for some visual feedback on the timbre.

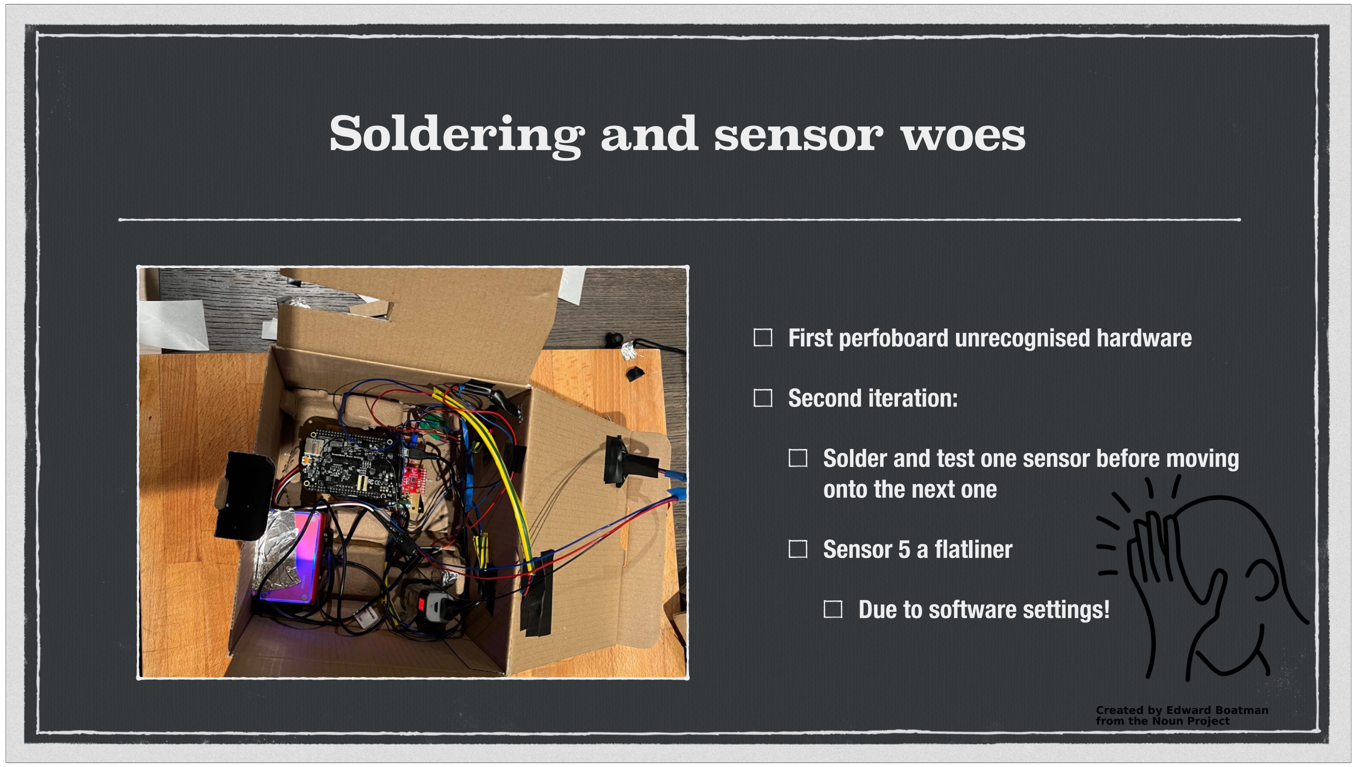
Hopefully this is still low enough control dimensionality, to lead to exploration of those hidden affordances, as discussed by [Zappi and McPherson 2014].



The sound engine is based on loading and playing back samples.
When playing back several samples at once on the Bela, a lot of buffer under-runs were detected and audible clicks were observed.

I tried a Pure Data solution for incrementally loading the samples, playing them back as they were being loaded. That helped a bit, but the solution is like a black box, so it was difficult to control the sample names with many variables and affecting the output with filters.

So currently the IMS is using a Pure Data external from one of the Bela examples.
This also resulted in buffer under-runs and audible clicks, until finally Joseph pointed out the simple solution of increasing the buffer size in the Bela IDE. It didn't completely solve the problem, but helped a lot!



Soldering the circuit to a perfboard was a bit challenging.

First I soldered the whole thing and then tried slapping it onto the Bela, which responded with not recognising the hardware, and asking if I had a cape.
I was definitely not wearing a cape.

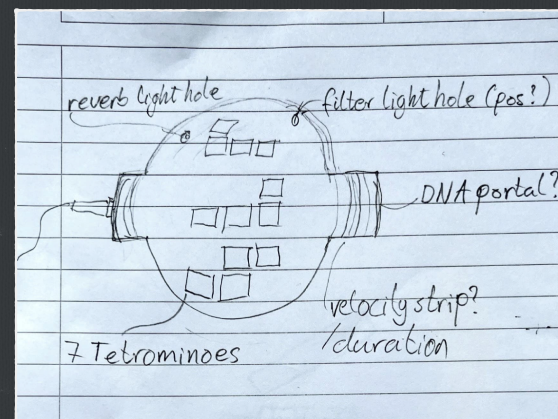
So for the second iteration the plan of attack was to solder and test one sensor at a time, before moving onto the next one.
That was successful until I reached the fifth analog sensor, which only provided zero readings.
I went from the perfboard back to the breadboard. Still zero.
Until finally realising, that when adjusting the software settings for the buffer sizes, I had casually also decreased the number of analog inputs, and then completely forgotten about it !

Results from preliminary user evaluation, with the unboxed IMS, indicate that conceptualising the different tetromino forms for musical chords was difficult, though it was somewhat enjoyable to look for new sounds.

Some visual representation of the chords was planned by that time, with drawings along the soft membrane sensor. Those could be supplemented with lights at each form, indicating which is active, but for now I opted for the aesthetics of simply two lights, which is influenced by the robots in the animation film Castle in the Sky, which I saw just recently.

Apart from aesthetics, this configuration required less soldering!
So now there are simple drawings of the tetromino forms to indicate where each has a place along the sensor.

Performer evaluation



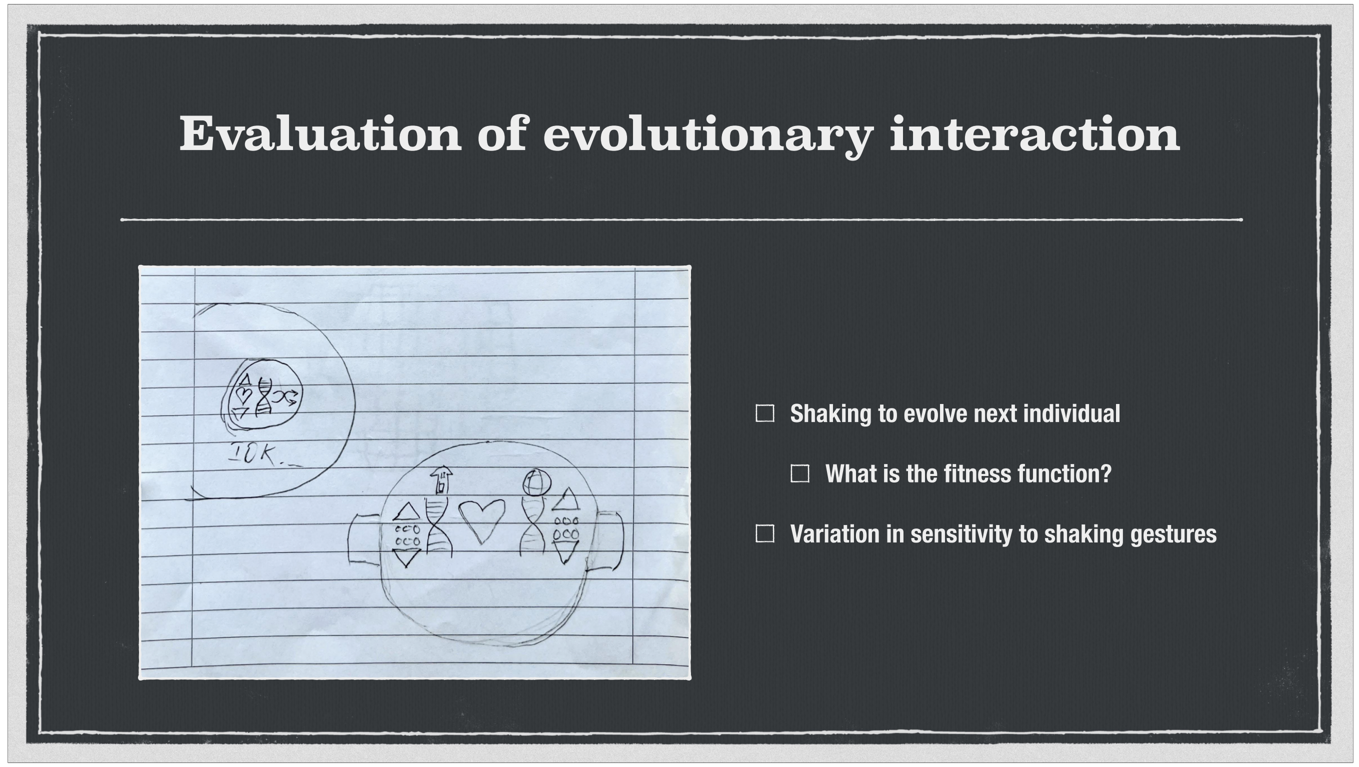
- ☐ **Third hand for increased bandwidth**

Cook, Perry R. 2009.
“Re-Designing Principles for Computer Music Controllers: A Case Study of SqueezeVox Maggie.” in NIME.

Holding that box, while also operating the sensor-controls, makes it sometimes desirable to have a third hand available.
So while there is a “Computer Music Controllers design principle” stating that some players have spare bandwidth,
here, increased bandwidth might be what’s needed.

The initial design of a sphere with “ears" sticking out for mounting it could help increasing that bandwidth.

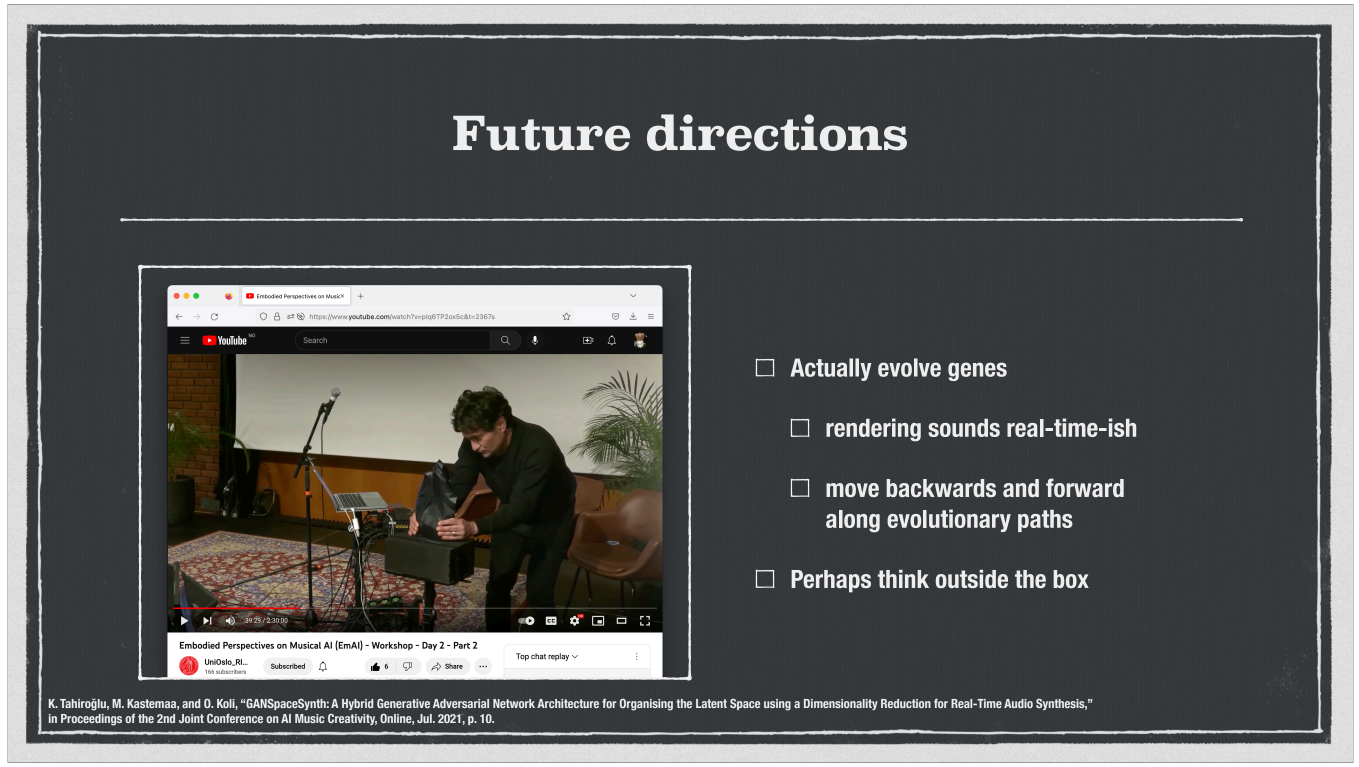
Ears sticking out - Shrek?



When allowing a couple of people from the robotics group at IFI to try and evaluate the (unboxed) IMS, and indicating that the shaking gesture was supposed to be for evolving sound genes, their main question was: What is the fitness function?

My best answer was to show them the preliminary sketches, which show some sort of buttons to indicate preferences for mating individuals - but using gestures other than button presses could be more interesting…

From a performer perspective, it helps to know that shaking the IMS will lead to new sound discoveries.
But one interesting realisation is that different orientations, of the Bela and the perfboard, resulted in varying sensitivity to the shaking gesture, where one configuration is very sensitive,
so it’s almost impossible to not discover new sounds by slightly moving the IMS.
Finding a balance between unwanted sound changes and ease of discovering this affordance is interesting.



The most interesting next step is to actually evolve genes while interacting with the IMS,
and hearing the rendered result in as close to real time as possible.
The current shaking gesture could be used for indicating that the an individual should be evolved further,
- but how to indicate that the current evolutionary path should not be followed, and that you’d like to go backwards, and to other directions? …

Seeing Koray’s performance during the workshop “Embodied Perspectives on Musical AI”, a couple of weeks ago, was quite inspirational.
Picking his brains after the performance I learned that different squeezing gestures, on the elastic slab, allow the performer to move forward and back in the latent space of the underlying GANSpaceSynth.

It would be good to find similar ways of navigating the space of audio features from sound-genes. And maybe that requires thinking outside that box.

But the original contribution probably lies mostly in the tangible navigation of tuning lattices
and an attempt to explore a gesture as an evolutionary interface.

https://youtu.be/A1m3Xp4wVgY

Thanks

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