**Feedback sheet for final version of sonification on chemical sensors:**

***Introduction video:*** <https://www.youtube.com/watch?v=-I8y_FUYg9Q>

***Example 1:***

<https://soundcloud.com/yuna-787448399/v5-alertrange-10-chn1-4/s-HQE30pUJp6k?in=yuna-787448399/sets/sonificationprotoptype_version5/s-WHKBASX0Ivy&si=2b560095393745fc87f8b96d57587715&utm_source=clipboard&utm_medium=text&utm_campaign=social_sharing>

***Example 2:***

<https://soundcloud.com/yuna-787448399/v5-alertrange-10-chn13-16/s-yKxnrnSGiLA?in=yuna-787448399/sets/sonificationprotoptype_version5/s-WHKBASX0Ivy&si=c5822d37fdd84bcbbae5d8128362c990&utm_source=clipboard&utm_medium=text&utm_campaign=social_sharing>

**Questions:**

1. Do you think this design helpful for monitoring data during a calibration session?

In principle, yes. For calibration what it is usually done is to stop measurements between calibration steps (which is going to increase or decrease the reading values), and allow the standard solution added to mix well. Then the measurements are resumed. In this case, there should be a jump in the values recorded and during the first seconds the signal may be unstable but should stabilize shortly after. As I understand, the pitch may be going up or down as it is stabilizing (starting from the new value\*), and in some cases create a click sound, but just in the beginning. Therefore, knowing this, this design works for calibration.

\* For calibration we start with base values: e.g. 380. Then we add calibration standard, a known concentration this would add a jump in the values (readings), e.g. 420. Then we add more and we jump to, e.g. 460. Then to 510, and so on. But the idea is that we stop the readings, and we resume them in a new point (value) that should, in theory, be stable, so the pitch should not change with respect to the starting point of that measurement or, if doing so, just slightly. If the sensor is not working properly, it may be more difficult to stabilize, and the changes may be producing click sounds.

2. Can you observe abnormal behaviours in data streams through this design? If yes, do you think you rely more on pitch information or click sound?

Yes. If it is not stable, I can hear the pitch going up and down. And if the sensor is not behaving properly (too noisy), I can hear the click sound on a regular basis. However, it may not mean a complete sensor failure.

The pitch would mean that the sensor is noisy (going up and down), which is not rare. And the click on a regular basis could mean that the sensor is not working properly (possible failure). These statements would be considering also the behavior of the rest of the sensors. If all the sensors are behaving similarly, it could be something related to the solution we are measuring. If only one or two of them are getting the clicks, we may be able to discard its data, or replace them in the field if necessary.

3. Do you think that the click sound mechanism can accurately reflect the severity of problems in data stream?

In principle yes. However, it may be interesting to study more in detail the threshold considered. And the relationship with the rest of the sensors.

For example, in channels 13-16 the second one, which is a failing sensor, we can hear the clicks on a regular basis (more than in the others), so this way we can discard in-situ the data provided or replace it with a new one if possible. Two of the other sensors are not working properly and they have a lot of clicks as well. This way we may suspect that the data provided is not good data and we need to check the sensors and replace them if necessary.

4. Can you easily deduce from this sonification whether there are any problematic sensors within a group and subsequently identify them?

Yes, but with a little bit of training. In particular, how it sounds when the sensor is failing and how it is a sensor that it is working. As I have the original data, I knew what sensors were not working, and I was hearing in detail. The ones that were not working properly have more clicks than the rest. In addition, you can hear a dramatic change in pitch. All together indicates that the sensor(s) is (are) failing and that they need replacement.

As you can identify the sensor, you can decide to continue collecting data with the rest of the sensors or replace the failing ones if possible. That is on the user of the sensors. This would be clearly beneficial in the field. Otherwise, you only know if the sensor is filing when processing the data in the lab after all the work of collecting. This would be too late if all the sensors are failing, and a waste of time.

5. Do you feel it hard to notice any changes in sonified data after listening to it for a period of time?

It can be a little bit monotonous, but this is good, as the change in pitch means that something is not right. The clicks are something good because it provides critical information. A large change in values in a regular basis means that the sensor is failing.

6. Any other suggestions/questions/description of feeling:

The introductory video is really good. It provides the information needed to understand the sonification of the data.

Regarding some of the other questions it may be interesting after collecting individual responses to have a discussion group.

Overall, it is a very good job. I like it, and I think it is useful to apply in the field.