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data_opera @ ars bioarctica

diary by Michael Schweiger

*Source: http://expanderrr.servus.at/dataopera/2013/10/01/data_opera-ars-bioarctica/*

Kilpisjärvi biological station

The great news is, that data_opera will visit <u>Kilpisjärvi biological research station</u> in November 2013, as we, Markus Decker and me, can follow the invitation for residency in "<u>Ars Bioarctica</u>" Program, because we finally made it to succeed in <u>Linz Export 2013</u> project application.

And here the station is located: <u>Kilpisjärvi biological station</u>

Aerial image of Kilpisjärvi from late 1980's. Kilpisjärvi biological station is located in the middle of the image, south of the road.
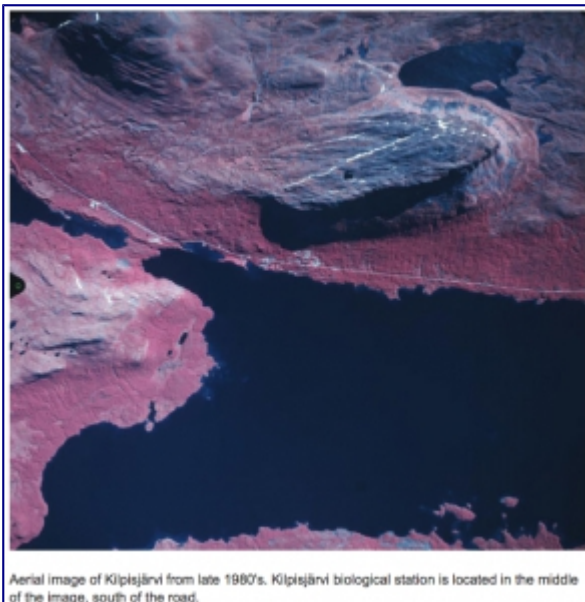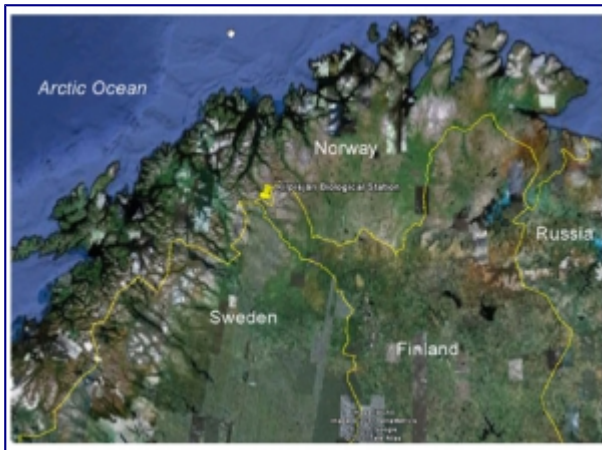
The filter-finding odysee:

For someone who does not know much about the huge variety of filter media and filter means that exist in lab-world it was a real odysee to find handy and usable stuff, or better put, to learn to know which could work which not and to find sources where to get the "good" ones for afordable price.

Finally it look I made it, I'll have at least 7 varieties of paper – filters and 4 very delicate membrane filters, which fit the size of the fans, which should be easily fit with the dust-sensors.

24 hours till takeoff:

The last weeks had been pretty busy … many different tools – filters, fans, arduino stuff, sensors, electronics, gathered in the atelier building a pile of gear that needed to be compressed in space and weight and therefore made a a process of rethinking and decision taking necessary that led finally to a surprising setup of the analogue synth that I'll take to the cold.

Packing the analog-synth:

I finally made it to squeeze all needed modules and power-supply into a small tool-box-suitcase, and thus realized, that I can fit up to 4 3HE 19″ rows into this small suitcase, as the top of it offers enough space to mount there two rows wit the small – simple modules.

In the pack – mode it looks a bit like a diletant's hell machine layout … I hope not to scare customs and securities at the airports to much. Especially as it will be packed suitcase in big suitcase, as there will be no way still to take it into the cabin as hand-baggage – it's simply to much in weight.

The journey: The approach to the station will take actually four days, one to reach Helsinki, two to pickup gear needed and ordered to wait in Helsinki – we are really lucky, that the Arsbioartica Chief Erich Berger is so kind, that he not only organized many things needed but unaffordable to take with the plane or to ship forehand but moreover lent some of his private equipment for our project – and one whole day – 22 hours min – to reach the station via train to Rovaniemi and bus to Kilpisjärvi. Details of the journey here.

Arrived at the station:

So we finally arrived at the Biological Station on Tuesday afternonn, tired but happy. It turned out that against latest information we got in Linz about one week before we departed we are not alone here!!! No there are at least 6 researchers of very different fields here so plenty chances for exchange, talk and inspiration and of course some help. It is a really great place here and we met an unbelievable nice and friendly welcome. This we think is the spirit of the station but of course the climate strongly influenced by Erich Berger the head of the Ars Bioarctica program too. Everyone is helpfull and it's so easy to get what needed and moreover there is great openness.

Day No° 1 – 20/11/2013

After some prowling around in the station we detected all areas in the station that we will need to use for both, of course for our work on the detail-projects as well as for our bodily and overall wellbeeing. So we started on Wednesday to move our stuff and tools to Lab No° 137 and unpacked all. Further we did some excursion to the area around the Station to find usefull spots for natural radio detection and some environmental measurements. So we got aware of the sometimes massive sounds the thin, new not yet stable ice surface emits, we checked that even when it is bright in the night some perticipation happens that is audible at least for the ears, but we did not yet manage to record some of it. On the first evening we were lucky to see the Aurora, did some long-time exposure series and unfortunately found out, that the (radio?) transmitter on Saana Mountain as well as all the Mains that is connecting the buildings which make up the scatterd station emitt more Noise and Signal than we expected … So we will have to do at least some of the radio detection near the station at the foot of Saana Mountain where we think we can find a spot where the Saana shadows the emissions of the transmitter on it's top.

Day No° 2 – 21/11/2013

After moving in the main goal for the data_opera project was to mount the analog synthesizer what needed several hours of unpacking of the modules testing functionality and mounting the modules in operational groups into the rack which had to be reconfigured too, as everything was dissasembled for the transport into smalles possible fragments. Unfortunately one of the most important modules, a dual sample and hold does not work anymore, it ssems one of the chips does not work anymore but besides that everything isfunctioning nice.

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Assembling the synth

First inspection of access into lab from outside to get outside air into the lab look good. Easy to find stuff to adapt the hairdryer= airflow-generator so this looks good.

Acces fom lab to environment

Day No 3 22/11/2013

This we decided is the perfect day to go onto Mt Saana to find possible locations for VLF recording in the shadow of Mt Saana to find spots free of radio and and other electromagnetic pollution and as well to visit the mountain top to get an overview of the landscape surrounding Kilpisjärvi.

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Day No 4 23/11/2013

First setback is, that the hairdryer gets too hot and stops working, restarts after a while and so on. Solution maybe is bypassing detaching the heating system as it can not shut off.
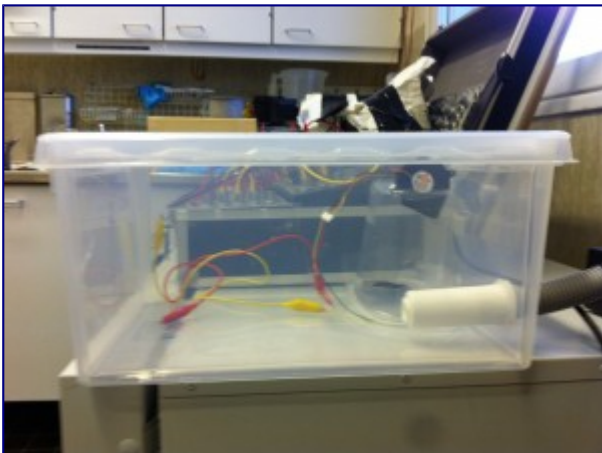
This seemed working good as the fan now even went faster what was even appreciated. But after a whil a smoky smell and after a closer look some blue sparks from the motor did not propose this will work this way. After a second try with the low fan speed the engine was working very weak so stop of this and test to run the fan dirctly from a wall-wart 12V powersupply did not meet the needs concweerning airflow strenght.

So next step thinking and start to build a prototype for the sensor station which will once located in the box detect dust.

Mounting it was easy to find transparent light housings for the sensor and to attach 12V server cooling radial fans for filtered in and out flow of the outside air. This works quite good, fans work good even with the filters attached. Communication with arduino and sensor data logging is no problem.

Day No 5 24/11/2013

The walk for a new hairdryer and some other needy stuff to solve the problem with transoprt of air into the box situated in the lab.

The Box for the sesnor array in the background mounted analogue synthesizer

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The box from above

This a day of sayings. First what you buy cheap you often need to buy twice. Kilpishalli K-Market shop has literarlly almost everything you need, even a cheaper, better hairdryer with a mode with out any heating involved and additionally a mode for cold shot, compared with the considered a good buy in Helsinki.

Kilpishalli the incredible shopµm

3 hours after the I left the staion I'm back, happy after a nice walk and lucky about I got the things I need.

Day No 6 25/11/2013

Mounting the new hairdryer with new and testing air flow in complete setup for long duration test.

Meanwhile sensor casing and tests with filters and datalogging. This showed, that the air is really clean, very low concentrations within the fine dust particle size. Broadband Filters, 3 to 15 µm work, but Filters 3-5 µm, 5-8 µm deliver very low concentrations and even longer periods without any detection, 8-11 µm and 11-13 µm work show higher concentrations but as well deliver periods of zero detection. That needs to be handled in the code for measurement data transfering to voltage output.

First tests to drive analogue synthesizer with voltages generated via the arduino works good, but shows the known ripple problem of PWM analog voltage output. Tests with simple lowpass filters show that the audio lowpass filters of the synth work better, as the frequency can be regulated and the design of those is better and meeting the needs for sound manipulation.
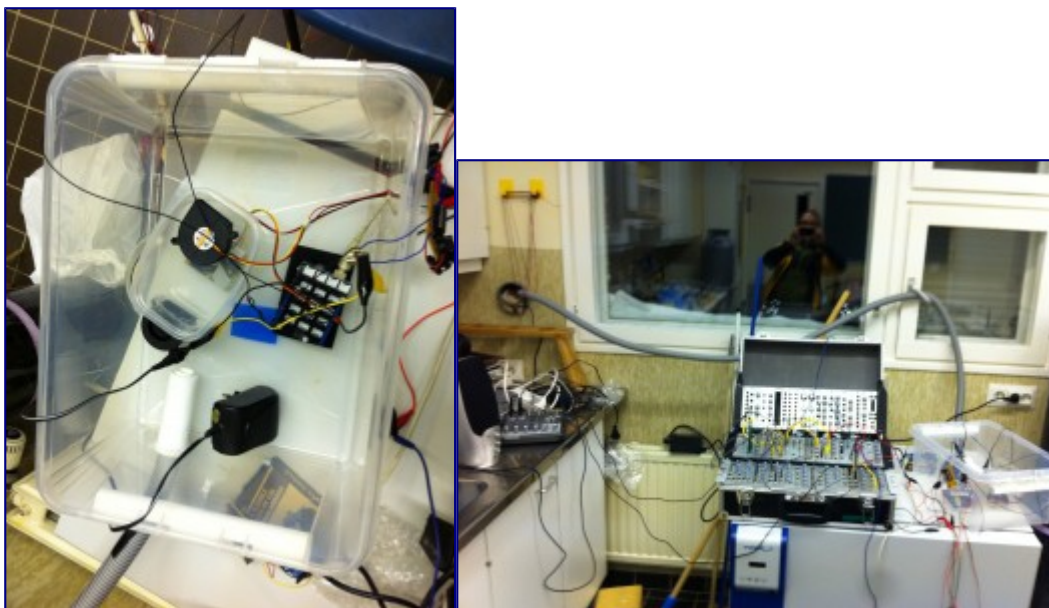
The need for 30s measurement cycles can be handled with slew controler and controled slew limiter.

Day No 7 26/11/2013

Works with the code takes a while, further sensor housing and optimizing for the problem of partikels remaining on the lens is second priority of today. In the evening further tests with the system running, but still without air from outside, as it is very windy and lots of snow is in the air. All that snowing that goes on cleans the air even more, so this is a day to stay in the lab and tests are run with indoor air, which is very low polluted too. As the Ardunio does not deliver enough power to drive at least 4 or 6 parameters needs darlington arrays, these where built on breadboard for test purpose. Tests showed unexpected behaviour, producing negative voltages, more strange ths did not happen with basic sketches used for frist tests, like sweep generator. So this must be the code, that leads to that.

Day No 8 27/11/2013

Markus Decker takes a look at the code and solved problem, which was that levels and level calculation was done in dezimal instead of hex. Now it works perfect. So no more obstacles to test the system first time in a sounding setup. Voltages where used to unharmonize a harmonic setup of three voices via filters (filterfrquenca and resonance), modulating pulsewith and fine-tuning of two of the three voices and a voltage controlled variable LFO that modulates mor filter parameters and FM of one oszillator. It sounds nice but the signal change according to the dust concentration is still a problem, as the concentration is changin rapidly but remains low. So darlington where driven with 6 V instead of 5 what led to better results. The nice experience is, that it even works with low concentrations, so higher concentrations easily found in urban spaces will give much more range to play with in terms of sound shaping. First recordings will take place tomorrow and I'm lucky that as it sounds now, I can finally get rid of the beard!

The whole setup during tests

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Day No 9 28/11/2013

Now as it looks like main things work the next step was to set up at least two sensor-cases each with different filters in the box and to connect the outputs via the darlington arrays to the analogue synthesizer and use at least four parameters straight forward and to use in additon at least two 2nd order parameters to shape the sound according too dust concentration and ratio, both measured in each sensor house in 30 second detection cycles. Due to the long detection cycles some slew limiting seemed to be necessary to smooth the changes between the current and the older measurement data. Further some cables had to be soldered, the sensor housings had to be re-arranged and as I found out not only the incoming air-flow of each sensor house needs to be filtered, but as well the out fans too.

Done all this and some tuning of the non influenced synth – four voices involved (two quantized at musical / chord laws and two without quantization) I started to work with the incoming data. Two voices pitch and some other parameter are controled directly by the incoming voltages 0.1 – 6.0 V and in addition two VC LFO's get controlled by the incoming data of particle concentration. These LFO's then control CV controlable parameters of Filters, Pulsewith of the Rectangle Voices and FM of one voice. As a further sourde of 2nd order data results of the analog comparator, which compare the dust concentrations of the two different particle sizes (12-15 µm and 5-µm). This leads to results which definitely react on changes in the air quality, but this is not yet meeting yet my audible / musical expectations, while I'm still happy the system works.

Day No 10 29/11/2013

Some search for math implementation into Arduino is in the first moment a backdraw, as I'd need faster AT-Mega boards and even that seems to be unlikely to work, as there would be needed to use the whole AVR Lib which exceeds the memory of the boards. But finally as it is mainly needed to transpose the linear data into logarithmic data logarithmic amplifiers based on op-amps will be the solution, unortunately these are not available here, so I stop further detail development of the system and will use more thinking on a new layout of the setup, as I realized, that decentralized measuring via split single sensor stations connected to the central soundgenerator – the analogue synthesizer is the solution to some problems not easy to be solved in an sensor array put into one box. Maybe this will make it possible to get rid of the fans or at least get rid of the need to have in and out fans for each sensor.

Further I see one more benefit of this, it makes it easier to make interactive or at least answering setups for exhibitions, as visitors if they move through room(s) opening doors etc. produce disturbance or even turbulence within the airbody and therefore transport particles to teh sensors and finally they bring particles in as they enter the space and as everyone of us is a carrier of dust.

So far so good.

Here a short excerpt from test recordings:
https://soundcloud.com/sonifer/dust-sounder-1

Day No 11/12 30.11/01/12 2013

First reflections:

In Helsinki I will set up the sensors with Arduino only to log some data with the same filters which are still in the sensor housings to get data for comparison with the data recorded at Kilpisjärvi.

Back in Linz there I have to dig the field of more accurate lowpass filters to get rid of the ripples on the PWM DC Voltages from the boards and look for circuits for some compression of the signals as low concentration and ratio of particles lead to low voltages while high concentration and ration tend to go over the maximum and are therefor limited with maximum voltage. Driving the darlington transistors with 9V should help as the CV inputs of filters and LFO's can be fed with 9V too. But still I have as well to look for a way to get rid of the linear relation between data and Voltage output, what would perfectly work with logarithmic function to process the data before sending it as depending Voltage.

Setup in installation be changed, I will build single stations containing sensor, microcontroler, darlington and other needed analog electronic circuits needed. The locations of single units setup will be choose as it seems to offer changes that emerge from visitors moving causing dust moving which changes the sound. The stations will be conected with one collecting analogue synthesizer rack, where the data related voltages will control pitch, PW of the squarewave oszillators, frequency and resonance or Q of the filters and further CV controlable LFO's.

Further I want to do some analogue math with the signals using comparators, analogue logic modules offereing AND / OR / XOR outputs to trigger for example Envelope Generators to fade the Volume of voices or other parameters.

Main idea is now to create an sound envrionment that relates to the dust moves in the envirnment where the installation is located. Environment is not seen as the rooms where the sensors are located only, but as well the entrance, a backyard, maybe the nearest street.

The entrance situation is most likely intersting, it makes the rooms and the outside environment communicate via airflow and turbulences which triggers changes in the acoustic environment.

I think further it needs to make a dislpay or whatever appropriate way of information about which sensors detect dust of which size of particles, of the relation between chosen particle sizes to observe in comparison to particles sizes and related maximum permissible values, and of course on relations of sound changes, sound design and musical interpretation of detected concentrations and maximum values allowed in air.

Day No 13 02/12/2013

Some more data logging, some tuning with the code before the dissasembling and the packing started, which then finally lasted for some hours till everything was apcked secure and transportable and sorted to make it easy to reach for the parts needed for data logging to be donne during the crypto-postcard workshop @ Made in Kallion in Helsinki.

Day N0 14 03/12/2013

the journey to Helsinki starts.