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OF NORWAY

Low-Cost Programmable Air Quality Sensor Kits in Science Education

Bjørn Fjukstad, Nina Angelvik, Maria Wulff Hauglann, Joachim Sveia Knutsen, Morten Grønnesby, Hedinn Gunhildrud, and Lars Ailo Bongo

UNIVERSITY OF TROMSØ


Støvsensor
Hold ren of fri for hindringer
Skolelaboratoriet, UiT
Inst. for informatikk


Olympics
Every four years, they come from Norway to plunder your gold
By Chuck Culpepper
Flag bearer Emil Hegle Svendsen leads Norway's Olympians during Opening Ceremonies. (Kim Kyung-Hoon/Reuters)
DAEGWALLYEONG, South Korea — If you surmise that your Olympic nation is as strong or as cool as Norway, then you are suffering some sort of delusion. In your defense, it's not like the Norwegians sit around up at the 59th parallel crowing about being the greatest. They just come to the harder, hardier version of Olympics, the Winter Games, bring along their majestic lungs and return home with medals by bushels.
They probably pay the odd baggage fee.
PyeongChang 2018
Norway is dominating the medal count, and it's time somebody did something about it
Dan Wetzel
Yahoo Sports Feb 18, 2018, 12:29 PM
TOPICS
Los Angeles Times
12 WKS/99¢ Ends 2/28
Trolls on Twitter make false claims of being assaulted at screenings of 'Black Panther'
Olympics Buzz: Norway's dominance in winter sports is hard to miss
By JOHN CHERWA
FEB 13, 2018 | 3:00 PM
Norwegian skier Johannes Hoesflot Klaebo is congratulated by fans after winning the men's cross-country individual sprint classic Tuesday at the 2018 Winter Games. (Franck Fife / Getty Images)
This is your daily infusion of information and news that you might have missed. The really big stuff you'll find in other stories.

Who I am

- PhD Student in Computer Science focusing on visualization and analysis of genomic data
- Coordinated the local coding club for over 3 years
- As a part of my position I teach coding classes to schools

Project Summary

- Students build and code sensor kits to study air quality in their local environment
- We provide an open platform to store and explore the collected data
- Pilot study in a Norwegian upper secondary school, now in 10 schools across Northern Norway
- Pedagogical resources with lectures and tutorials
- Everything is open-sourced at airbit.uit.no

Motivation

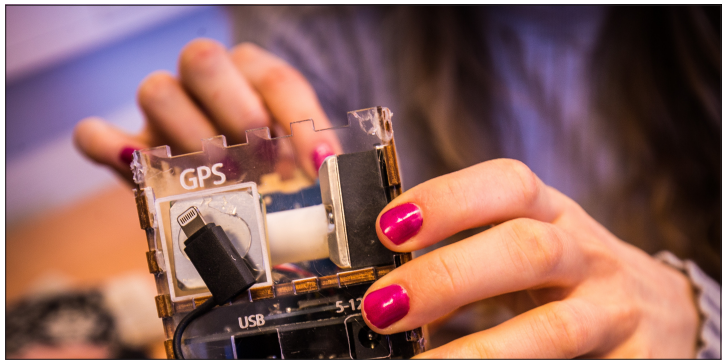
- Digital skills are poorly expressed in the different subjects throughout Norwegian education.
- Norway falling behind due to lack of courses, lack of teacher courses, teaching material.
- Norwegian students simply use technology, they don’t develop any new technology
- In the upper secondary school they have a “Technology” subject with room for larger projects

Air Pollution

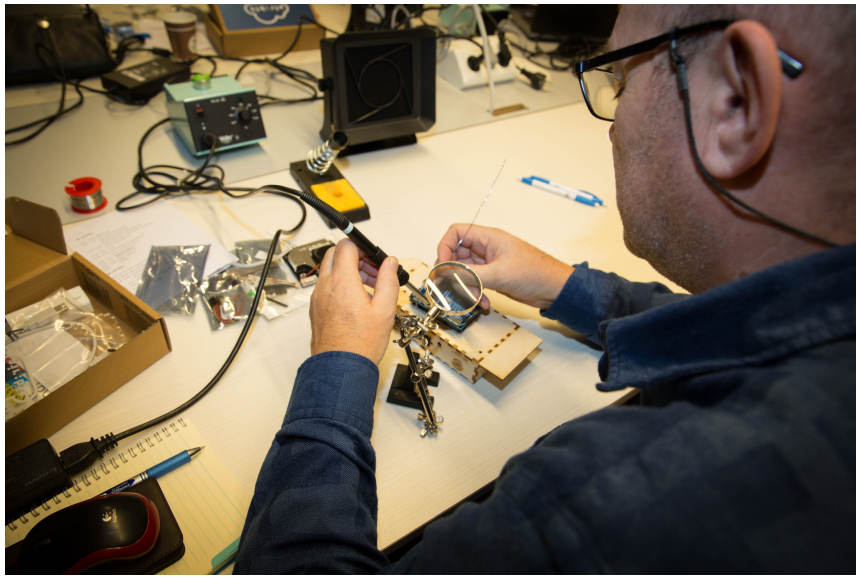
- A global health issue that reduces quality of life in polluted areas and causes diseases.
- The Norwegian government continuously monitor and create air pollution forecasts
- In Northern Norway the air quality is rapidly changing during the winter months mainly due to cars with studded winter tyres and emissions from diesel powered cars

Our Course

- Maker inspired citized science project where students study air-quality patterns in their community
- Introduce computer-science and engineering in Norwegian upper secondary schools
- Teachers and students choose what to study and can tailor the course to fit the class



Course contents

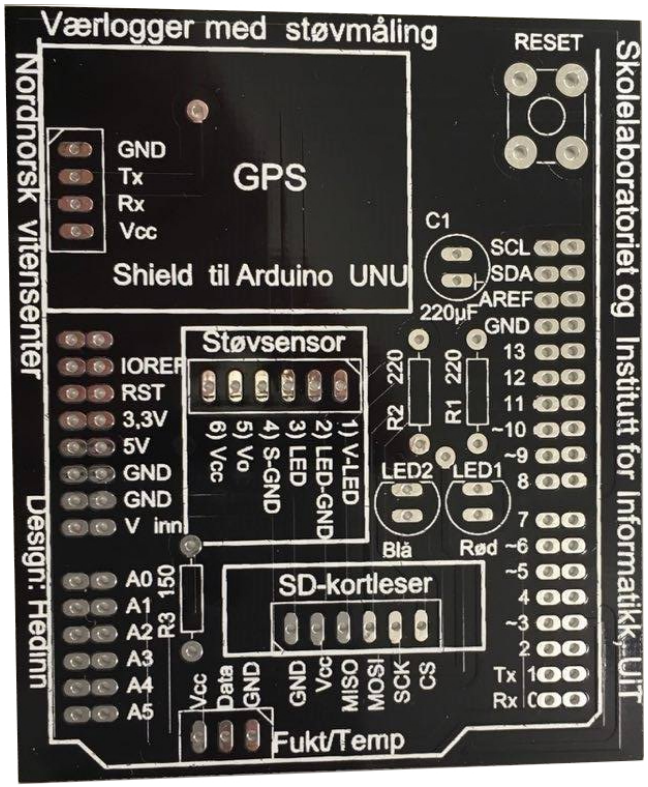


- The air:bit project spans a semester, but classes combine it with other projects
- Two-day teacher workshop
- Typical course structure
  - Introduction and inspiration
  - Kit assembly and configuration
  - Data Collection and analysis
  - Summarize findings in a report or presentation

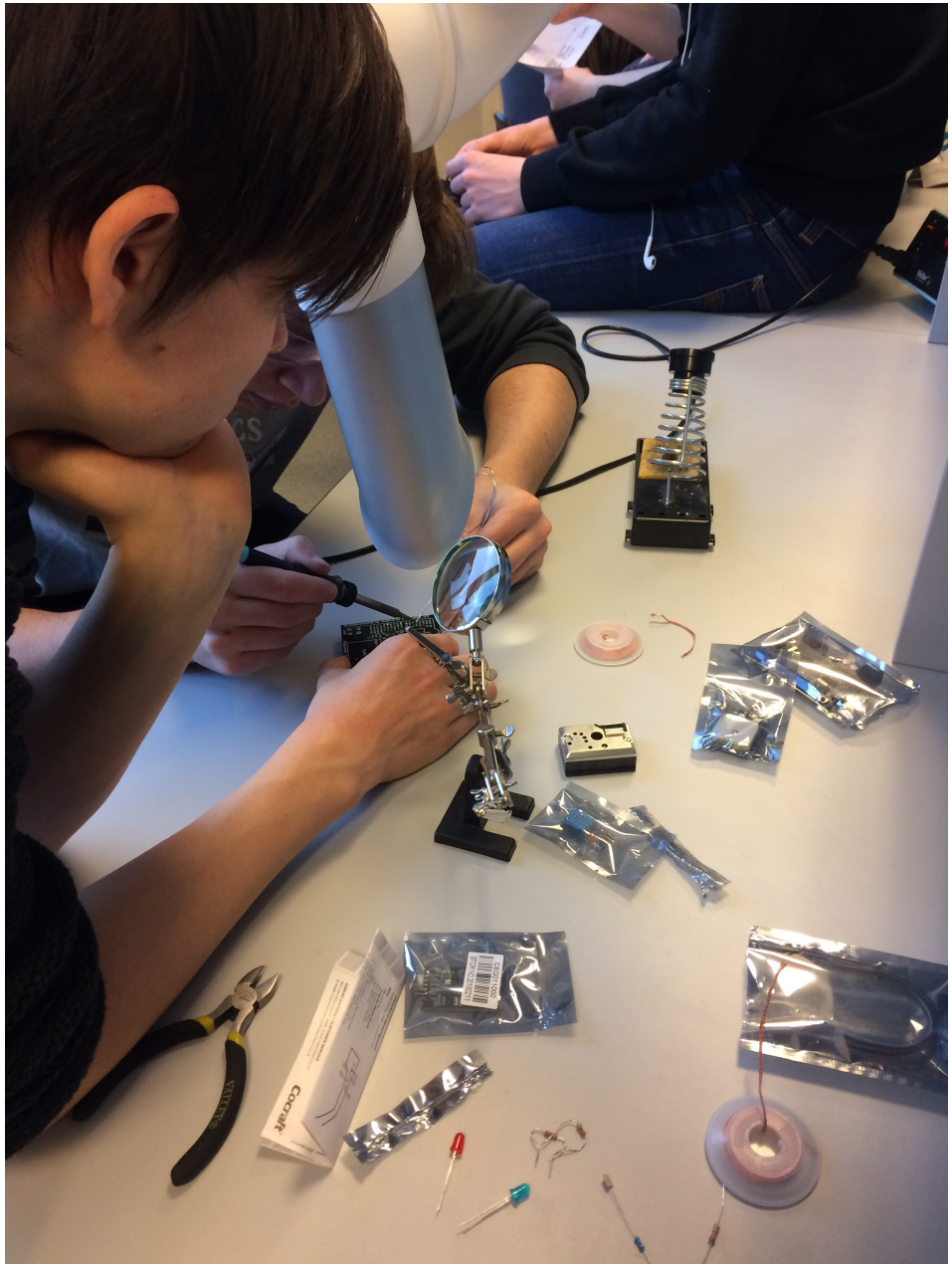
air:bit

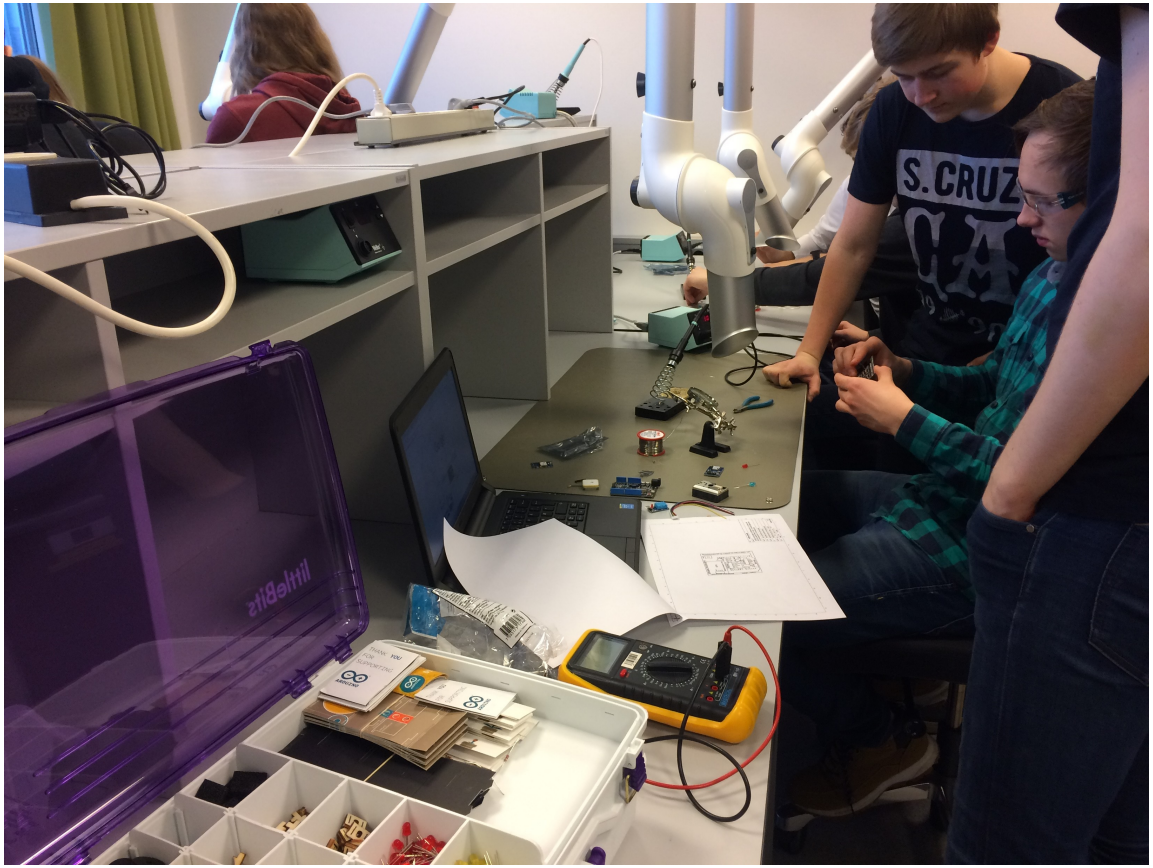
- Arduino microcontroller
- Sensors: Dust, temperature, humidity, GPS
- Storage: Memory card

air:bit details



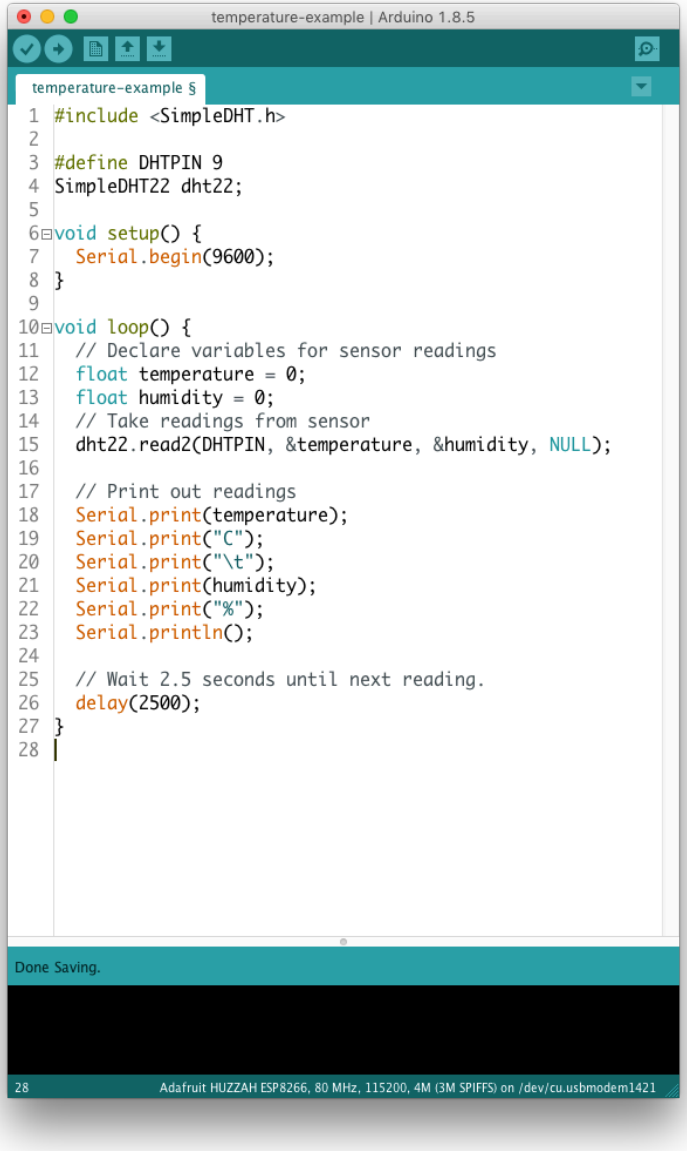
Component	Cost (USD)
Arduino Uno microcontroller	$3.14
NEO6MV2 GPS module	$8.19
Sharp GP2Y1010AUOF optical dust sensor	$5.99
DHT11 temperature and humidity sensor	$1.00
SD Card reader and 16GB memory card	$4.74
Portable power bank	$15.00
Two indicator leds and resistors	$1.00
Custom PCB circuit board	$2.00
Total:	$41.06




S.CRUZ

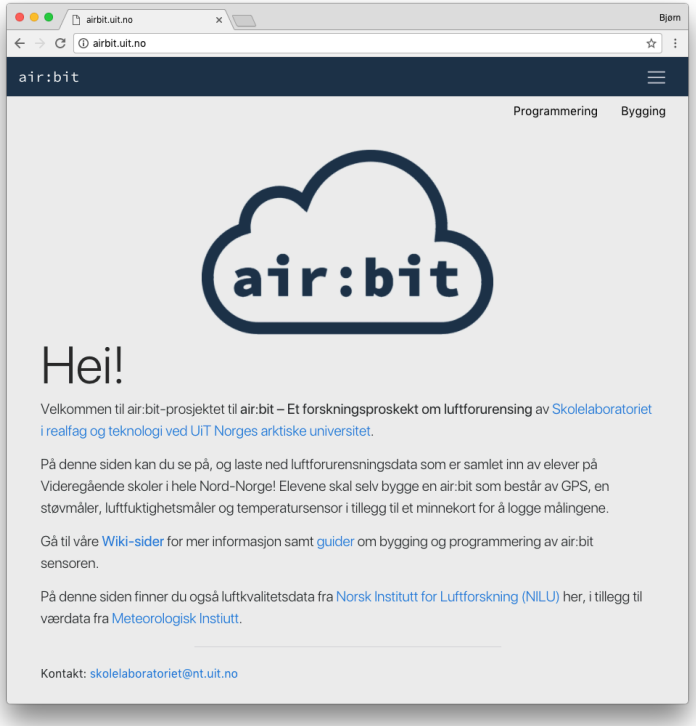
Coding

- We provide example code and tutorials for each component
- Students assemble a fully working solution themselves



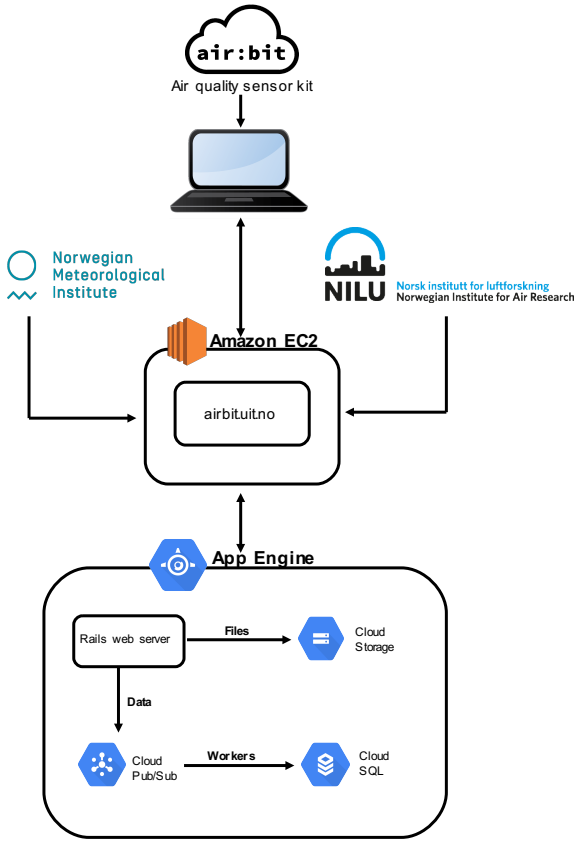
Online Resources

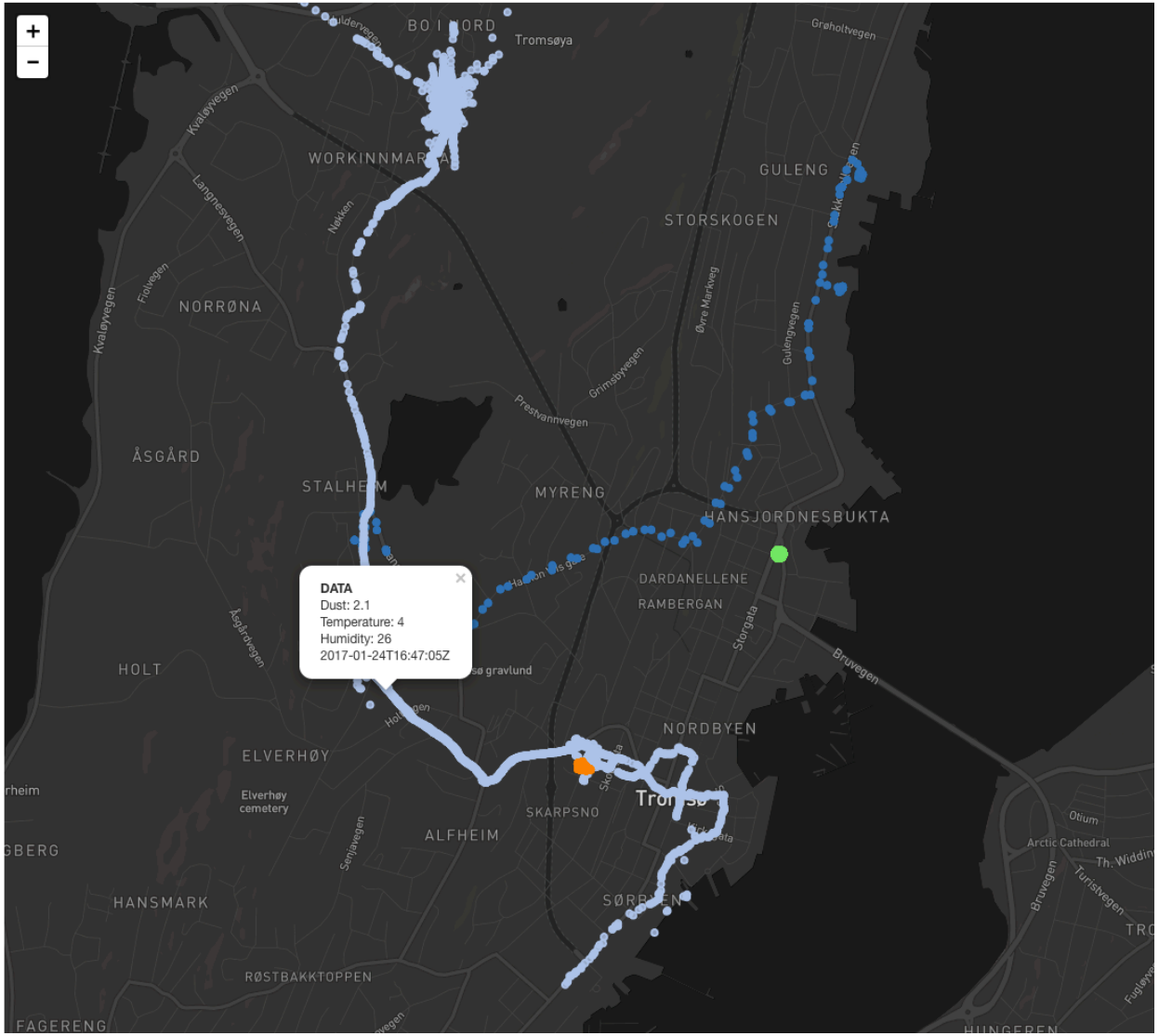
- Website for students and educators
- Tutorials on how to assemble the kit as well as coding examples
- Upload and explore collected air quality data
- Online at airbit.uit.no



Air Pollution Data Analysis Platform

- Built by a master student, Nina Angelvik, presented as a poster here at ACM SIGCSE 2018
- We store all data in a SQL database on Google Cloud Platform




DATA
Dust: 2.1
Temperature: 4
Humidity: 26
2017-01-24T16:47:05Z
Tromsøya
WORKINNMARKA
GULENG
STORSKOGEN
NORRØNA
ÅSGÅRD
STALHEIM
MYRENG
HANSJORDNESBUKTA
DARDANELLENE
RAMBERGAN
HOLT
ELVERHØY
NORDBYEN
SKARPSNO
ALFHEIM
HANSMARK
RØSTBAKKTOPPEN
FAGERENG
Elverhøy cemetery
Storgata
Bruvegen
Grøholtvegen
Kvaløyvegen
Langnesvegen
Nakken
Frolvegen
Grimsbyvegen
Prestvannvegen
Øvre Markveg
Gulengvegen
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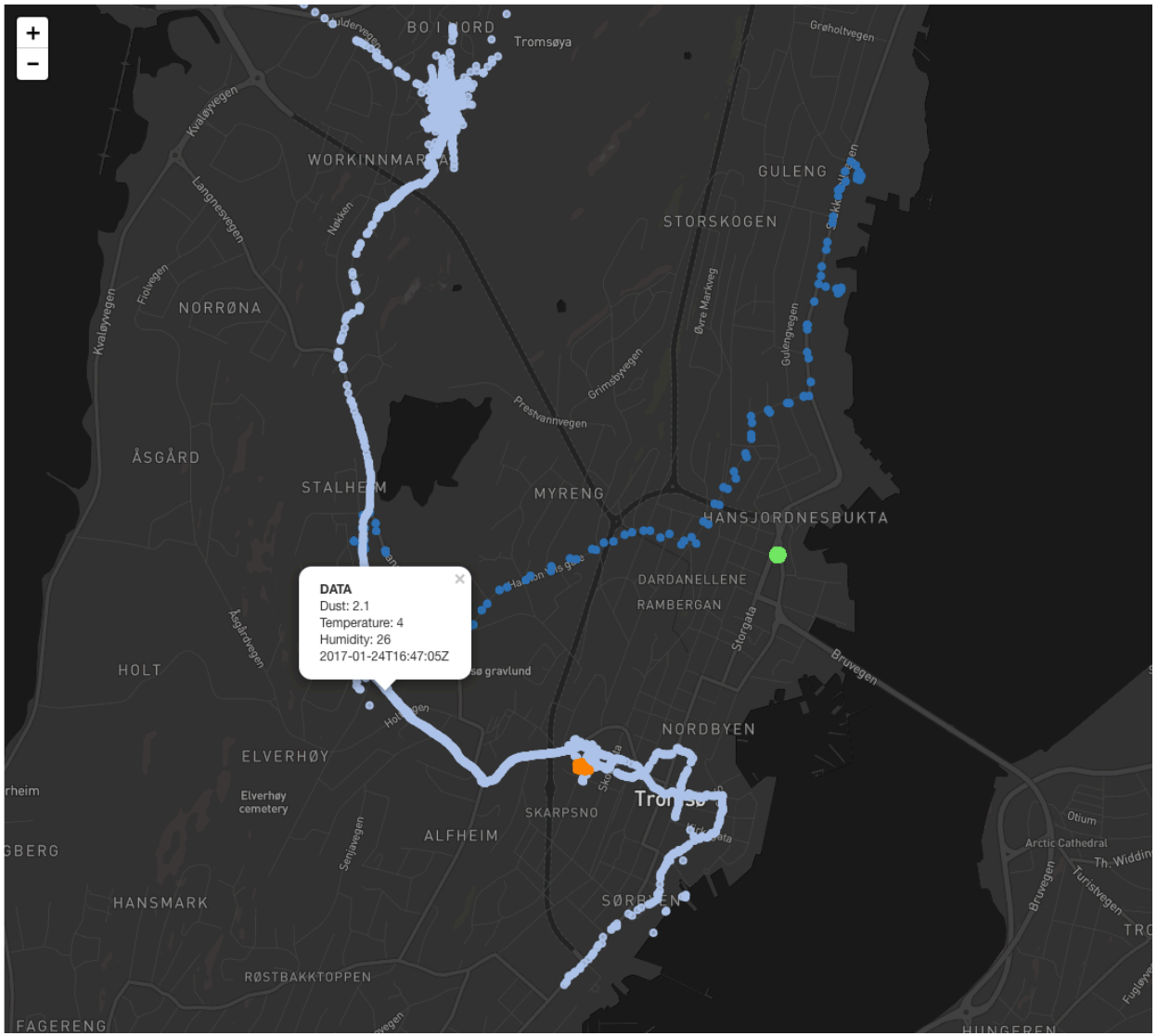
Senjavegen
Otium
Arctic Cathedral
Turistvegen

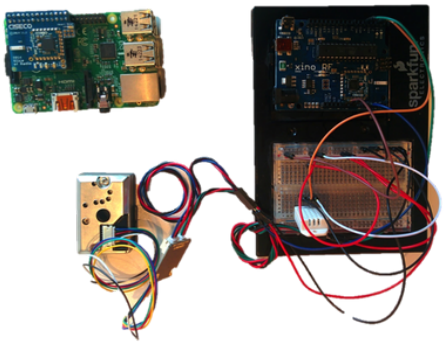


Note on Privacy

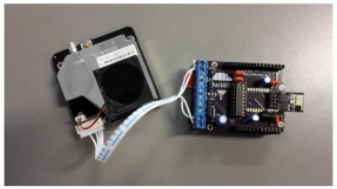
- Students are given information on how the data is used and stored
- We have consent from the participating students to share the data

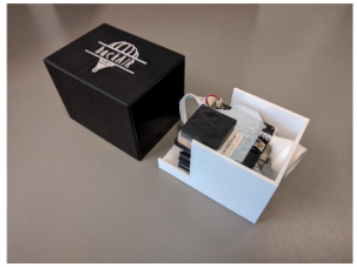
Air Pollution Engagement Projects

- Friskby Bergen (friskby.no) a Norwegian project similar to ours where they use a Raspberry Pi connected by WiFi

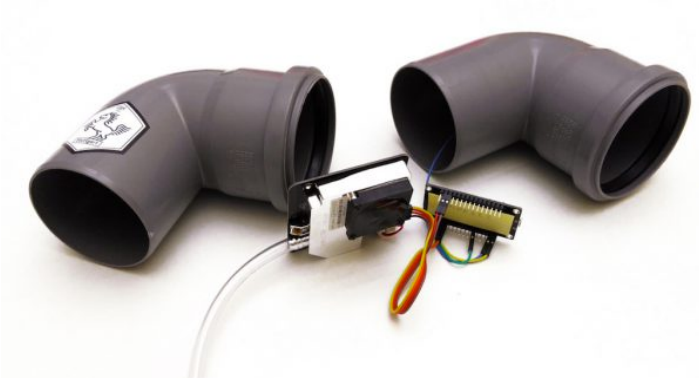


- hackAIR (hackair.eu) is a European project to engage citizens in air pollution





- Luftdaten (luftdaten.info) is a project from Germany where they host workshops and events

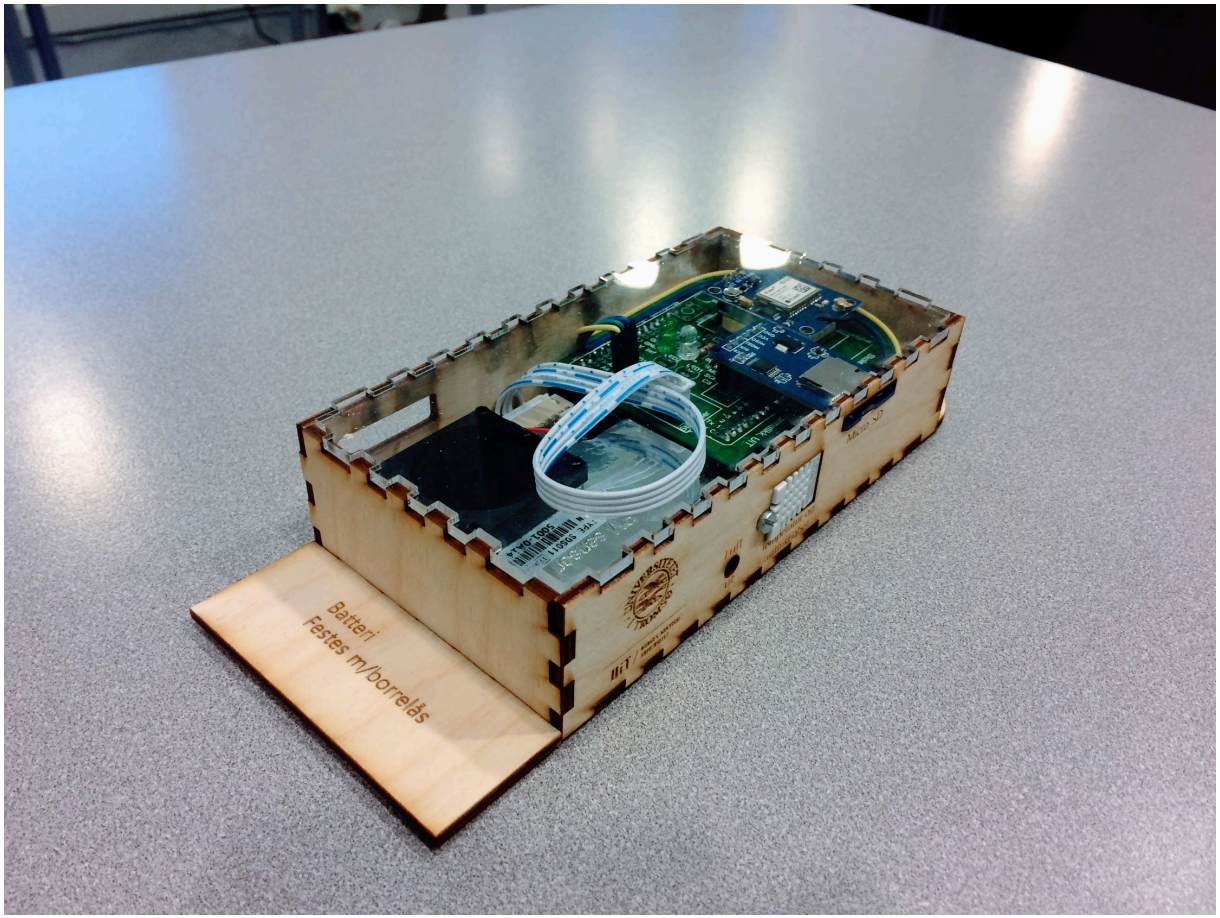


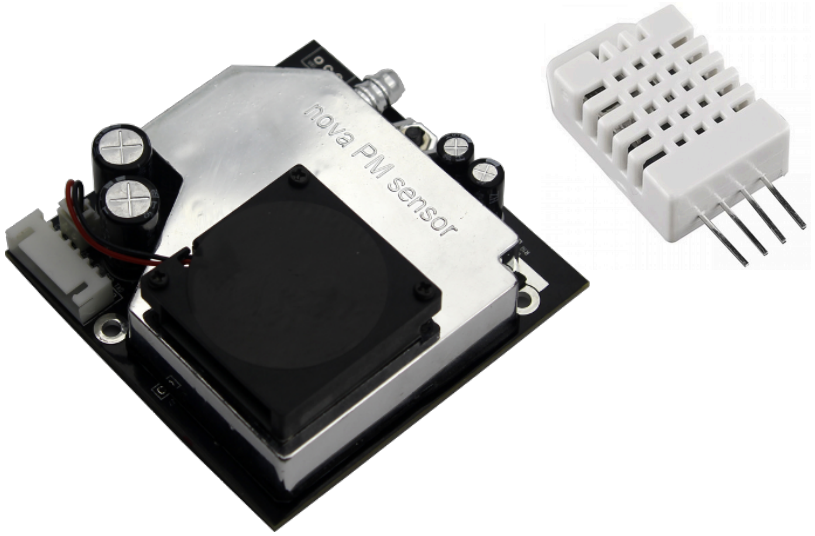
Experiences and lessons learned

- Given once in 2017 in a class of 26 students in groups of 3-4.
- Assembly and soldering without any major issues
- Coding was by far the most challenging part of the course

Future directions

New design





PM2.5 / PM10

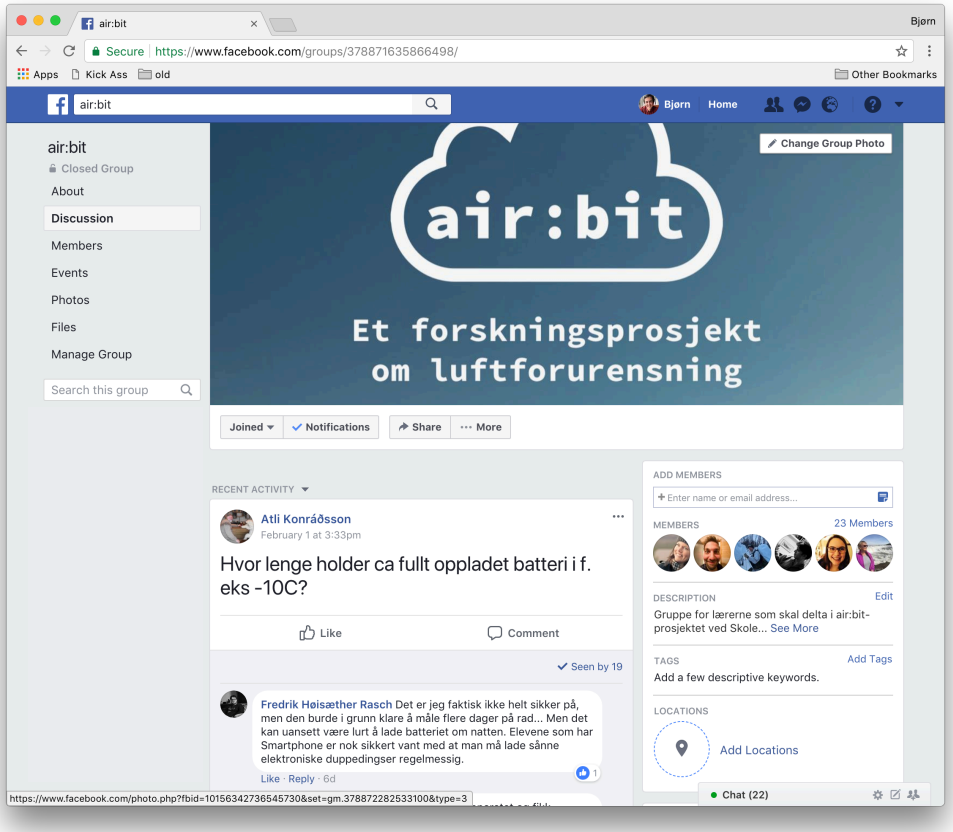
-40 - 80°C ± 0.5°C

~~0 - 50°C ±2°C~~

11 schools this spring

Community

- Created an online community for participating teachers
- Q&A
- Sharing experiences and helping other teachers



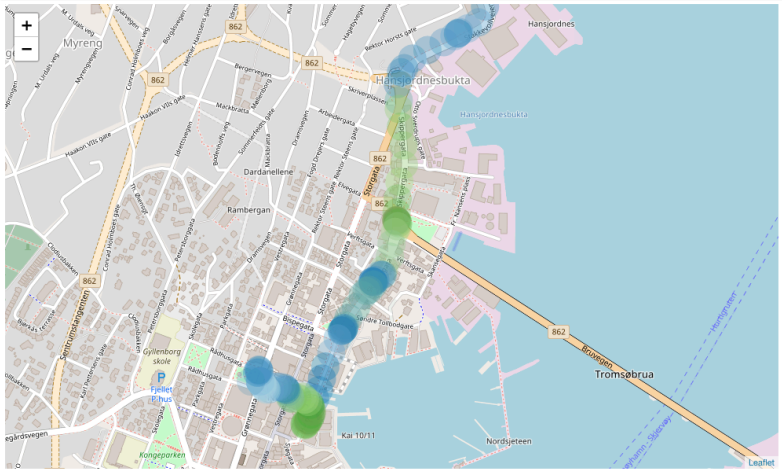
Reusing the air:bit

- Reuse the completed kit in lower grades
- One class will reuse the kit for a “hiking trail mapping assignment” where they will map different hiking trails using the air:bit

Data Science?

In [12]:
```
# La oss se hvordan dataene ser ut på et kart. Koden
# under plotter en sirkel for hver koordinat og fargelegger
# den ut fra PM10-målingen.

import folium
from numpy import interp
import branca.colormap as cm


m = folium.Map(location=[69.6492, 18.9553], zoom_start=14)

for index, row in data.iterrows():
    lat = row[' Latitude']
    lng = row[' Longitude']
    pm10 = row[' PM10']
    interpl_pm10 = interp(pm10, [1,10], [0,1])
    c = cm.linear.Paired(interpl_pm10)
    pop = "PM10: "+str(pm10)

    folium.Circle(location=[lat,lng], radius = 30, stroke=False,
                  fill=True, fill_color=c,
                  popup=pop).add_to(m)

m
```

Out[12]:



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fjukstad.github.io / airbit.uit.no

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